10-1989

Resource Conservation Act Analysis: A Documentation of the Endogenous and Exogenous Livestock Sectors of the Agricultural Resource Interregional Modeling System

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Abstract
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Disciplines
Agricultural and Resource Economics | Agriculture | Economics | Environmental Policy

RESOURCE CONSERVATION ACT ANALYSIS:

A Documentation of the Endogenous and Exogenous Livestock Sectors of the Agricultural Resource Interregional Modeling System

by Burton C. English, William Terry Disney,
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Technical Report 89-TR12

October 1989

Center for Agricultural and Rural Development
Iowa State University
Ames, Iowa

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TABLE OF CONTENTS

Table of Contents (Continued)

PREFACE

This work began in 1981, and includes the contributions of numerous individuals. The authors wish to thank graduate research assistants Mauricio Jaramillo and Eswaramoorty K. for their aid in data collection and Quinton Grafton for his work on pasture costs. The computer programming tasks were significant and could not have been accomplished without the programming skills of Doug Haney and Bruce Eveland and the meticulous keypunching of Charlotte Latta. Finally, the efforts of Anne Norwood must be acknowledged as she typed numerous drafts of this publication.

The development of this sector would have been much more difficult without the expertise of Paul Rosenberry, Iowa State University. The documentation certainly would not have been as sound without the Project Advisory Committee's guidance -- Klaus Alt (Economic Research Service), Walt Butcher (Washington State University), Earl Heady (Iowa State University), Larry Libby (University of Florida), David Post (Soil Conservation Service), and Thyrele Robertson (Soil Conservation Service).

Finally, this project was made possible through the funding provided by the Soil Conservation Service and Hatch funds provided through Iowa State University's Experiment Station (project 102-40-06-06-2497) and the University of Tennessee's Experiment Station (project number TN00841).

LIST OF TABLES

List of Tables (Continued)

List of Tables (Continued)

List of Tables (Continued)

LIST OF FIGURES

CHAPTER I. INTRODUCTION

One of the major sectors within the Agricultural Resource Interregional Modelling System is the livestock sector. There are two types of sectors developed in this manuscript. When location and rations of the livestock sector can be fixed, and the analysis is not going to significantly impact the sector, a fully exogenous sector can be implemented. However, in many cases location of livestock production depends on the competitive nature of each region. This can change as a result of a shift in production, resource limitations, resource surpluses, changes in resource availability or costs, etc. If the analysis is to evaluate the impacts these types of changes will have on livestock, then a partially endogenous livestock sector is required.

The livestock sector is impacted by government policy. However, all too often, these impacts are ignored. As Robinson (1975) indicates

> Policies adopted with respect to grains obviously do influence the prices of livestock products...These secondary effects will be considered, but the important point to keep in mind is that most policy discussions, now as in the past, focus on grains and tend to ignore the rest of agriculture. (p.770)

Not only do commodity programs impact the livestock industry but the resource policies also have this same potential. Inherent in many soil conservation plans are rotations. These rotations typically contain some forage which can only be used by certain livestock products. Land retirement may be achieved allowing or disallowing forage. Without livestock included within the model, these types of policies cannot be fully evaluated.

The Livestock Industry

Between 1970 and 1984, gross income from beef, dairy, eggs, pork, poultry, sheep, and turkey increased by nearly 140 percent (Table 1 and Figure 1). In 1984, beef receipts accounted for 44% of the gross income with pork contributing 25% (Figure 2). The share that livestock has of gross farm income is 40 percent.

Beef, pork and egg production has remained relatively constant during the past fourteen years (Table 2). Sheep production has decreased. The production of broilers, dairy products, and turkeys have increased during this same time span.

Over the past 20 years, many changes have taken place in the structure of livestock production in the United States. As a result, the composition of inputs required in the livestock production process has also undergone significant change. This has led to many unanticipated problems for the infrastructures that support the various livestock industries in specific areas, as livestock farms have increased in average size and concentrated in fewer areas of the United States. This fact has also been the cause for increasing concern by policy makers in rural areas concerned with preserving the "family farm" in their political territories.

As early as the late 1960s, many agricultural economists were becoming aware of just how significant the changes in United States livestock production could be. As profit margins in livestock farming dwindled, costs of farm labor soared, and capital requirements multiplied, it became obvious that major shifts in many aspects of agricultural production were forthcoming (Ball and Heady, 1972).

Table 1. United States' gross farm income and income from livestock enterprises, 1970-1984

Year	Gross Farm Income	Gross Income for:							Gross Income Livestock
		Beef	Dairy	Eggs	Pork	Poultry	Sheep	Turkey	
		(billion dollars)							
1970	58.8	13.9	6.7	2.2	4.7	1.5	0.3	0.5	29.8
1971	62.1	15.2	6.9	1.8	4.1	1.5	0.3	0.5	30.3
1972	71.1	18.6	7.3	1.8	5.4	1.7	0.3	0.5	35.6
1973	98.9	22.8	8.2	2.9	7.7	2.8	0.4	0.5	45.3
1974	98.2	18.3	9.6	2.9	7.1	2.5	0.4	0.9	41.7
1975	100.6	18.0	10.1	2.8	8.2	3.0	0.4	0.7	43.2
1976	102.9	19.8	11.6	3.1	7.8	3.1	0.4	0.8	46.6
1977	108.8	20.7	11.9	3.0	7.5	3.2	0.4	0.8	47.5
1978	128.4	28.8	12.8	2.9	9.0	3.7	0.5	0.9	58.6
1979	150.7	35.7	14.8	3.4	9.3	4.2	0.5	1.2	69.1
1980	149.6	32.5	16.7	3.3	9.2	4.4	0.5	1.2	67.8
1981	166.0	30.1	18.2	3.7	10.0	4.8	0.4	1.3	68.5
1982	161.6	30.4	18.3	3.5	10.8	4.6	0.5	1.2	69.3
1983	150.6	29.2	18.9	3.5	9.9	5.0	0.4	1.3	68.2
1984	174.0	31.2	18.0	4.1	9.8	6.2	0.5	1.7	71.5

[a]Does not include income from the selling of chicks.

Source: (United States Department of Agriculture, 1986).

Figure 1. Gross income for the U.S. livestock sector, 1970-1984

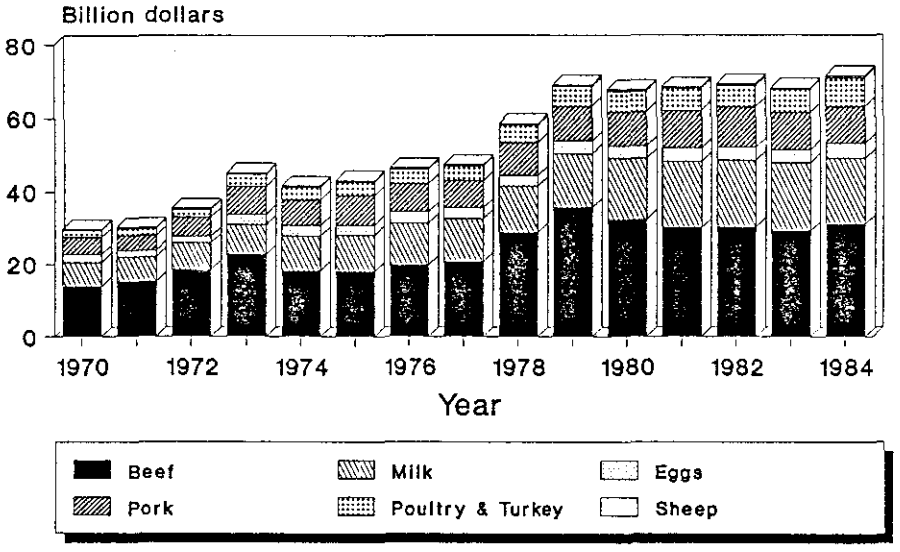

Figure 2. Share of gross receipts by livestock type, 1984

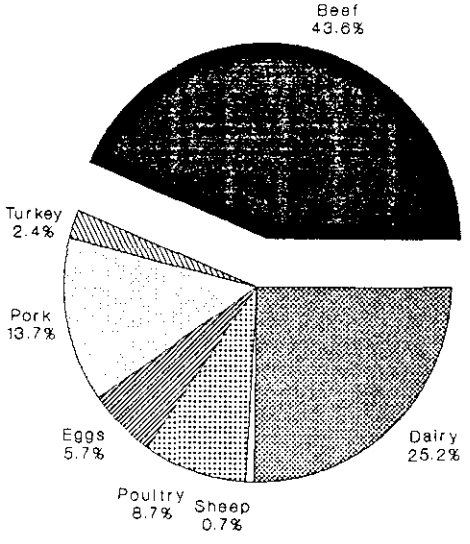

Table 2. Livestock production in the United States, 1970–1984

Year	Beef	Broilers	Dairy	Eggs	Pork	Sheep	Turkey
	....(million pounds)....			(million)	....(million pounds)....		
1970	39,343	10,819	117,007	68,212	21,823	1,099	2,198
1971	39,434	10,818	118,566	69,649	22,832	1,071	2,256
1972	41,225	11,480	120,025	69,219	20,919	1,004	2,424
1973	41,231	11,220	115,491	66,039	20,154	896	2,452
1974	42,761	11,320	115,586	65,620	19,976	807	2,437
1975	40,901	11,096	115,398	64,626	16,835	785	2,277
1976	41,398	12,481	120,180	64,511	18,160	733	2,606
1977	40,745	12,961	122,654	64,602	19,021	706	2,593
1978	39,971	14,000	121,641	67,157	19,466	687	2,655
1979	38,803	15,522	123,350	59,209	22,617	704	2,958
1980	40,283	15,539	128,406	69,686	23,402	746	3,077
1981	41,178	16,520	132,770	69,825	21,813	772	3,264
1982	40,715	16,760	135,505	69,718	19,658	785	3,175
1983	40,301	17,038	139,672	68,169	21,195	768	3,336
1984	40,000	17,855	135,444	68,193	20,177	692	3,386

[a]In 1979 the egg data includes layers and eggs destroyed because of possible PCB contamination.

[b]Beef, broilers, pork, sheep, and turkey information is expressed in liveweight terms.

Source: (United States Department of Agriculture, 1986).

Probably the most obvious change in livestock production over the last 20 years has occurred in the production of grain-fed beef. Today, industrialized commercial beef feedlot operations dominate in the production of grain-fed beef, with less than 450 of these "farms" accounting for more than one-half of the national production of grain-fed beef (Schertz, 1979).

As pointed out in a recent assessment of future agricultural resources, the changes that have been occurring, and will continue to occur in the future within other types of livestock production, are not as obvious. This is because such changes, especially regional shifts in the production of such land-based livestock production activities as cow-calf operations and (to a lesser extent) farrow-to-finish pork operations, do not come in the form of major or rapid shifts, but only as gradual adjustments over time (Fontenot, 1984).

Location of Production

An analysis of past U.S. Agricultural Census data tends to support this observation. Tables 3 and 4 show how the national production of feeder beef cattle and pork have been distributed between the nine U.S. Agricultural Census Divisions (Figure 3) over the last four census reports. Interestingly, proportioned production of feeder cattle has remained fairly constant between census divisions since 1969, with only small relative decreases in the proportions of total United States production occurring in the West South Central Division and small relative increases in the proportionate production in the Pacific Division. Other divisions have had small fluctuating changes in

Table 3. U.S. Department of Agriculture Census Division percentages of national feeder beef cattle production for 1969–1982

Region	Percentage of national production (1969)	(1974)	(1978)	(1982)
New England	0.97	0.85	0.93	0.95
Middle Atlantic	4.11	3.68	4.05	4.15
East North Central	11.08	10.26	10.50	10.51
West North Central	27.18	27.32	26.92	26.46
South Atlantic	8.30	8.92	8.95	9.10
East South Central	9.60	10.44	9.25	8.94
West South Central	20.61	20.01	20.36	19.94
Mountain	12.11	12.25	12.43	12.81
Pacific[a]	6.05	6.27	6.61	7.12
U.S. production[b]	45,511,356	51,912,414	44,445,284	44,985,290

[a]Excluding Alaska and Hawaii.

[b]Based on census data on the number of cows and heifers that have calved.

Sources: (Bureau of Census, 1971, 1976, 1980, 1984).

Table 4. U.S. Department of Agriculture Census Division percentages of national pork production for 1969–1982

Region	Percentage of national production (1969[a])	(1974)	(1978)	(1982)
New England	0.12	0.10	0.10	0.08
Middle Atlantic	0.98	0.18	1.58	1.82
East North Central	30.60	27.57	26.42	27.13
West North Central	50.76	52.97	52.82	53.68
South Atlantic	7.86	8.39	9.33	8.97
East South Central	5.27	4.66	4.81	4.02
West South Central	2.47	2.71	2.62	2.11
Mountain	1.32	1.72	1.69	1.61
Pacific[b]	0.62	0.70	0.63	0.60
U.S. production[c]	NA	66,730,709	71,204,875	74,675,363

[a]Assumes same percentage of total numbers are feeder pigs as reported in the 1974 Census, since no disaggregation occurred in the 1968 Census data.

[b]Excluding Alaska and Hawaii.

[c]Based on census data for number of hogs sold, excluding feeder pigs.

Sources: (Bureau of Census, 1971, 1976, 1980, 1984).

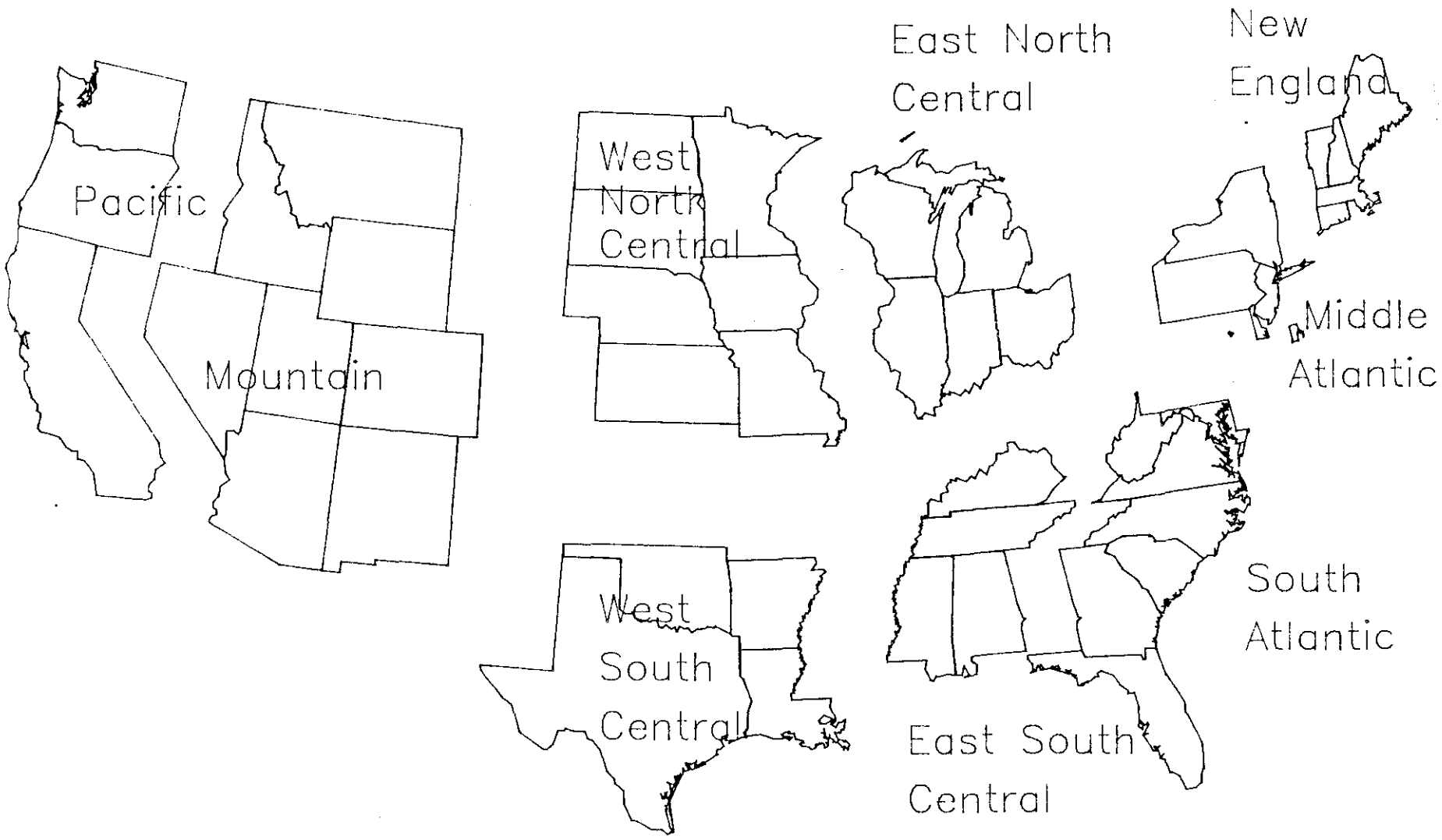

Figure 3. The nine U.S. agricultural census divisions

proportion between census reports or relatively minor changes in proportion since 1969.

By contrast, Table 4 shows that the changes in proportionate production of pork by census division have been more consistent since 1969, with the West North Central Division's share of national production increasing by 3 percent at the expense of the East North Central Division. Other divisions seem to be experiencing decreasing proportionate shares of national pork production, with the exception of the South Atlantic Division, which has shown minimal increases.

Changing Farm Numbers

In contrast to the slow, but gradual, farm numbers shifts in the regional production distribution of feeder beef cattle and pork, is the rate at which regional farm size distributions have been changing over the past 20 years. Trends towards larger and more cost efficient feeder beef and pork producing farms in almost all census divisions have led to substantial decreases in farm numbers. Tables 5 and 6 show how farm numbers in each of the census divisions that produce significant quantities of feeder beef cattle and pork, have changed since 1969.

Overall farm numbers among the seven significant feeder beef producing divisions were down 17 percent below 1969 farm numbers in 1982, with the East North Central Division showing the largest drop (27 percent below 1969 numbers). It should be noted, that feeder beef farm numbers in 1982 were slightly higher than the respective numbers in 1969 for the South Atlantic Division. But, the 1982 farm numbers in the South Atlantic Division still show a decreasing trend in farm numbers when compared to 1974 and 1979 census data.

Table 5. Changes in total number[a] of feeder beef producing farms between 1969 and 1982 census reports

Aggregate region	Number of farms by census report year (1969)	(1974)	(1978)	(1982)
East North Central	157,637	149,753	124,958	115,499
West North Central	297,834	286,389	243,236	223,855
South Atlantic	73,823	88,120	78,274	74,506
East South Central	117,498	133,347	110,933	103,221
West South Central	180,613	177,292	176,052	162,673
Mountain	53,491	54,567	49,974	47,729
Pacific	28,256	29,837	27,742	26,612

[a]Excluding those farms producing less than 10 feeders per year.

Source: (Bureau of Census, 1971, 1976, 1980, 1984).

Table 6. Changes in total number[a] of pork producing farms between 1969 and 1982 census reports

Aggregate region	Number of farms by census report year (1969)	(1974)	(1978)	(1982)
East North Central	142,285	96,526	87,442	66,278
West North Central	243,334	180,436	168,492	127,290
South Atlantic	66,508	44,070	51,352	27,277
East South Central	64,674	37,780	45,895	23,547
West South Central	28,438	15,343	21,502	10,059
Mountain	10,496	7,379	8,618	5,123

[a]Excluding those farms producing less than 10 hogs per year.

Source: (Bureau of Census, 1971, 1976, 1980, 1984).

Table 6 shows that the number of farms producing pork has declined even more rapidly. Total farm numbers reported in the 1982 Census of Agriculture for the six significant pork producing divisions were less than one-half the total number reported in the 1969 census. The two census divisions responsible for the majority of pork production in this country experienced declines in farm numbers of 53.4 percent (East North Central) and 47.7 percent (West North Central) between 1969 and 1982.

Regional Size Distributions

As mentioned above, a major reason for the decline in farm numbers has been the trend towards larger farm units. Tables 7 through 13 show how the distribution of feeder beef producing farms by size has changed over the last five census reports for each of the census divisions with significant feeder beef cattle production. Tables 7-10 show that there are relatively few feeder beef farms producing more than 200 feeder cattle per year in the East North Central, West North Central, South Atlantic, and East South Central divisions. It is also clear that the relative number of farms producing 200 or more feeder cattle per year in those divisions has not changed substantially over the last 20 years. The more revealing results from Tables 7-10, however, are the substantial shifts in the relative percentages of small farms (10-49 head) and medium farms (49-199 head) over the last 20 years. This shift is most pronounced in the East North Central Division, where a 20 percentage point decline in small feeder beef farms has been accommodated by a similar increase in percentage points by medium-sized feeder beef producing farms. Similar shifts from small to medium-sized

Table 7. Historical feeder beef farm number percentages by size in the East North Central Division

Number of feeder cattle produced	Percentage of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-29	94.036	88.026	82.298	79.241	74.866
49-199	5.703	11.809	17.307	20.276	24.506
200-500	0.239	0.152	0.369	0.441	0.5706
>500	0.0224	0.0133	0.0267	0.0424	0.05714
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 8. Historical feeder beef farm number percentages by size in the West North Central Division

Number of feeder cattle produced	Percentage of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	82.444	78.294	69.562	70.386	67.117
49-199	16.271	20.253	28.057	27.140	29.895
200-500	1.108	1.276	2.103	2.140	2.595
>500	0.177	0.178	0.278	0.333	0.394
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 9. Historical feeder beef farm number percentages by size in the South Atlantic Division

Number of feeder cattle produced	Percentage of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	84.733	78.581	76.306	77.677	76.350
50-199	13.236	18.883	20.698	19.272	20.398
200-500	1.456	1.878	2.267	2.277	2.468
>500	0.574	0.658	0.729	0.774	0.784
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 10. Historical feeder beef farm number percentages by size in the East South Central Division

Number of feeder cattle produced	Percentage of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	87.226	84.238	79.199	82.233	81.274
50-199	11.627	14.599	19.186	16.393	17.339
200-500	1.021	1.045	1.426	1.204	1.250
>500	0.126	0.117	0.190	0.170	0.142
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 11. Historical feeder beef farm number percentages by size in the West South Central Division

Number of feeder cattle produced	Percentages of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	79.784	74.592	69.327	74.472	72.726
50-199	17.264	34.019	26.400	21.824	23.387
200-500	2.322	4.086	3.391	2.938	3.088
>500	0.629	0.952	0.882	0.765	0.799
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 12. Historical feeder beef farm number percentages by size in the Mountain Division

Number of feeder cattle produced	Percentages of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	52.871	50.322	45.691	48.425	46.358
50-199	36.904	38.014	39.779	37.351	37.870
20-500	7.988	9.149	11.064	10.878	11.874
>500	2.237	2.514	3.467	3.346	3.918
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

Table 13. Historical feeder beef farm number percentages by size in the Pacific Division

Number of feeder cattle produced	Percentage of total feeder cattle farms in the region (1964)	(1969)	(1974)	(1978)	(1982)
10-49	65.731	51.397	56.618	56.755	55.402
50-199	26.334	31.275	30.154	28.963	28.708
200-500	6.000	8.802	9.498	10.262	11.088
>599	1.935	2.527	3.730	4.019	4.809
	100	100	100	100	100

Source: (Bureau of Census, 1966, 1971, 1976, 1980, 1984).

feeder beef farms have occurred in the West North Central Division and, to a lesser extent, in the South Atlantic and East South Central divisions.

A further look at Tables 11-13 shows that the percentage of feeder beef farms in the small-sized category has decreased, although not as significantly as above, in the three western-most census divisions over the last 20 years. However, one should note that in the West South Central, Mountain, and Pacific divisions, these decreases in relative small numbers have been offset by shared increases in relative farm numbers by medium-sized and large-sized (200-500 head) feeder beef farms. In the Mountain and Pacific divisions, there have also been substantial increases in the relative percentage of feeder beef farms in the extra large (> 500 head) size classifications.

As suggested by the sharper declines in pork farm numbers, the trend towards larger farm size has been much more pronounced in the production of pork. Tables 14-19 show how the distribution of pork farms, by size, has changed since 1959 for each of the six census divisions with significant pork production. Tables 14 and 15 show that small (10-59 head) and medium (50-199 head) sized pork farms in the two census divisions, that account for approximately 80 percent of the national production of pork, have been replaced in large quantities by pork farms of the medium-large (200-500 head), large (500-599 head), and extra large (> 1,000 head) size classifications. Unfortunately, consistent data on the number of pork farms producing more than 1,000 hogs per year are not separately available from census data prior to 1982. Table 20, however, shows how significant farms in the extra-large

Table 14. Historical pork farm number percentages by size in the East North Central Division

Number of hogs sold	Percentage of total pork farms in the region					
	(1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	45.103	32.981	30.744	29.762	28.955	25.067
50-199	41.504	45.212	40.577	38.850	36.660	32.705
200-499	11.439	16.765	20.568	20.236	20.196	21.321
>500	1.955	5.042	8.111	11.152	14.189	20.907
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 15. Historical pork farm number percentages by size in the West North Central Division

Number of hogs sold	Percentage of total pork farms in the region					
	(1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	38.733	27.933	24.521	21.198	20.764	16.697
50-199	48.854	51.226	44.375	41.363	37.710	32.961
200-499	11.366	17.774	24.327	26.044	26.074	26.399
>500	1.047	3.068	6.778	11.295	15.453	23.944
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 16. Historical pork farm number percentages by size in the South Atlantic Division

Number of hogs sold	Percentage of total pork farms in the region (1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	78.550	66.617	57.907	52.272	53.092	47.766
50-199	19.113	28.022	30.996	32.878	31.261	29.358
200-499	2.047	4.212	8.170	9.53	9.454	11.328
>500	0.290	1.500	2.926	5.318	6.193	11.548
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 17. Historical pork farm number percentages by size in the East South Central Division

Number of hogs sold	Percentage of total pork farms in the region (1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	78.590	67.064	59.387	54.635	62.830	49.301
50-199	18.740	28.988	31.340	33.984	24.197	33.164
200-499	2.378	3.009	7.219	7.830	8.975	10.226
>500	0.293	0.944	2.053	3.552	3.999	7.309
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 18. Historical pork farm number percentages by size in the West South Central Division

Number of hogs sold	Percentage of total pork farms in the region					
	1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	81.416	67.326	61.059	55.576	69.311	57.601
50-199	16.353	26.958	28.444	29.868	19.138	27.550
200-499	1.865	4.266	7.831	9.027	7.608	8.429
>500	0.366	1.450	2.665	5.533	3.943	6.421
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 19. Historical pork farm number percentages by size in the Mountain Division

Number of hogs sold	Percentage of total pork farms in the region					
	(1959)	(1964)	(1969)	(1974)	(1978)	(1982)
10-49	72.033	61.074	55.650	50.291	57.835	48.607
50-199	24.333	30.504	31.869	31.156	23.920	28.424
200-499	2.792	6.436	8.765	11.384	10.794	11.377
>500	0.843	1.986	3.716	7.169	7.270	11.592
	100	100	100	100	100	100

Source: (Bureau of Census, 1961, 1966, 1971, 1976, 1980, 1984).

Table 20. Percentage of pork producing farms by U.S Census Division reported as "extra large" (>1,000 head sold/year) in 1982

Aggregated region	Percentage of total farms[a]
East North Central	9.2097
West North Central	9.2922
South Atlantic	6.4120
East South Central	3.1214
West South Central	3.33336
Mountain	5.76666

Source: (Bureau of Census).

size classification were in 1982, with those farms composing almost 10 percent of all pork farms in the East North Central and West North Central divisions.

Tables 16-19 show that the size distributional trends, in the other four census divisions considered as having significant pork production, have followed similar patterns, with larger farms making up a larger percentage of total farm numbers. It is important to note, however, that the only size classification showing decreasing percentage points in the South Atlantic, East South Central, West South Central, and Mountain divisions is the small-sized farms. This indicates that the size distributional shifts occurring in the less important pork producing areas of the country are following a more gradual course similar to feeder beef producing farms.

Objectives

The objective of the remainder of this report is to present a model capable of evaluating many of the above concerns. The model will either be partially endogenous or fully exogenous depending on research needs. The coefficients for both are presented in this document. First, a general description of the model is presented. In Chapter III, a fully exogenous model is developed. The partially endogenous model is illustrated in Chapter IV.

Examples of studies that have used this model's methodology include:

1. Shraufnagel and English, 1982, and
2. Disney, 1985.

CHAPTER II. A GENERAL DESCRIPTION OF THE AGRICULTURAL RESOURCE INTERREGIONAL MODELLING SYSTEM'S LIVESTOCK SECTOR

During the past seven years, in the national analysis conducted by Center for Agricultural and Rural Development, the need for a flexible livestock sector became readily apparent. During the 1980 Resource Conservation Act, the lack of a flexible livestock sector resulted in a diminished ability to fully analyze the impacts of various resource goals. Without a livestock sector, the adjustments that might occur as a choice between rotations incorporating hay and changing the present ration of the beef herd cannot be made. The impacts of technological advances in the dairy, beef, etc. sectors could not be fully addressed. Projected changes in consumer tastes from grain fed towards roughage fed beef and the subsequent impacts and our resource base could not be evaluated. In order that these and numerous other issues could be analyzed, two different types of livestock sectors are built—

1. A fully exogenous livestock sector (FELS), and
2. A partially endogenous livestock sector (PELS).

The purpose of this document is to provide an insight into the structure and development of the livestock sector used in the Agricultural Resource Interregional Modelling System's linear programming model. In general, a livestock sector as a component of a national linear programming model should reflect the most important aspects of livestock production. For the purpose of the RCA analysis, two types of livestock sectors are developed. The first type has fixed location of production characteristics and somewhat fixed feed

requirements. This type of model is termed Fully Exogenous Livestock Model (FELM). The second type of model allows location of production to shift for some livestock types. This model is called a Partially Endogenous Livestock Model (PELM).

Exogenous vs. Endogenous

An exogenous livestock sector is built to economize on model costs at the expense of the detailed information provided by an endogenous sector. The exogenous livestock sector assumes regional distribution of production of livestock is fixed. When combined with feed use coefficients this regional production determines the regional demand for feedgrains which is added to the human, industrial and export crop demands in the model. Livestock water demands and nitrogen supplies are also derived and provided to the model before solving. Thus, the exogenous livestock sector excludes important information on regional livestock location and interactions between crop production and livestock feed demands, while providing a low cost method of reflecting livestock demand for feedgrains, concentrates, roughages and water and supply of nitrogen.

The partially endogenous model allows production to shift from one producing area to another in an effort to minimize costs. Regional final livestock demands are prespecified. Activities that produce the endogenous livestock commodities are incorporated and linked to the cropping sector.

When considering whether the livestock sector should be exogenous or endogenous, an evaluation must be made on the likelihood of livestock

production and feed requirement shifting. If shifts are not desired and livestock rations are fixed, the livestock requirements can be prespecified and thus exogenously determined. In this case, the livestock feed demands are placed in the model prior to solving by crop. There are some cases where shifts in rations are desired within the feedgrain and roughage categories. Feedgrains, barley, corn, oats, and sorghum can be aggregated together and placed in feed grain (corn) equivalents; and roughages, corn silage, legume hay, nonlegume hay, and sorghum silage can be aggregated together. In the final case, there may be a need to allow shifts in the location of agricultural production. This solution would require a partially endogenous livestock sector where beef, pork, and dairy subsectors are endogenously solved. Complete selection of location and rations is allowed within biological limitations.

The remainder of this publication discusses these alternatives and the formulations necessary to devise the required coefficients. This is achieved by first discussing the fully exogenous model and then the partially endogenous model.[1] Each of these models are available in the Agricultural Resource Interregional Modelling System.

Fully Exogenous Livestock Sector

The fully exogenous livestock sector (FELS) contains the feed requirement for beef, broilers and chickens, dairy, eggs, pork, turkey, and sheep. In addition, the manure produced by these livestock products

are determined. The water needs are also calculated. However, these water requirements are not used in the model.[2] The methodology used to develop these data requirements are presented in Chapter 3.

Partially Endogenous Livestock Sector

Once the decision is made to construct PELS, the question of which livestock type should be included is raised. Since poultry[3] production's location is fairly fixed, and it's not land oriented; it will not be endogenous. Sheep are also not incorporated within the modelling framework. As with poultry, its demand on resource use, crop requirements, and water are prespecified and location is predetermined in both models. The methods used to determine these coefficients are presented in Chapter 3.[4]

The endogenous livestock sector produces dairy, pork, and beef. The production process is modelled using nutrient requirements (JA), offspring (NA), demand for replacement animals (-NA), and capital, (CA) as inputs. These inputs, when used, produce dairy, pork, or beef to meet the final demands. The production activities can be broken into two types--final demand producing and offspring producing. The offspring producing activities do produce some red meat, however.

The dairy subsector produces milk as a primary product. However, steer calves are available for use by the beef subsector and roughage fed beef through culling is produced to meet final demands.

Pork production is presented through three production processes. These included farrow-finish, finish, and feeder pig. The feeder pig operation supplies piglets to the other two production processes. In

addition, it supplies some pork (from the culls) to meet the pork final demands.

The final livestock commodity produced in the model is beef. Beef final demands are divided into grain-fed and roughage fed. Cow/calf and cow/calf/yearling operations produce heifers and steers for use in the finishing activities. In addition, these activities supply beef to the roughage fed final demand through the culling of the breeding herd. Both the grain and roughage fed activities produce beef and require offspring.

Data Sources

Nine basic sources are used for the construction of the livestock sector. These sources include:

1. The Firm Enterprise Data System (FEDS),
2. The National Research Council publication on nutrient requirements of livestock,
3. Published and unpublished CARD working papers,
4. Various editions of Agricultural Statistics,
5. The 1949 through 1978 Census of Agriculture,
6. The National Interregional Agricultural Projection System,
7. Future Agricultural Technology and Resource Conservation, and
8. Unpublished regional and national data,
9. Feed Situation Reports.

An explanation of how these sources are used in the development of the model will be addressed in the following two chapters.

A General View of the Agricultural Resource Interregional Modelling System

A general schematic of the linear programming model is shown in Figure 4. This schematic represents two crop producing areas (x and y) within one market region/livestock producing area (z), and one ecosystem (g). Generally, the types of resources required, active constraints, and commodity demands are presented vertically with the activity types listed horizontally. The symbols used in this schematic are the same as those used in the mathematical representation that follows in the next section with definitions presented in Table 21.

As can be readily seen, the feed transfer activities (XJ) serve as the linkage between the crop and livestock sectors. There are two other activity types that are documented in Chapters 3 and 4. They are the livestock producing activities (XA) and (XB). In addition, this document illustrates how the right-hand-sides for exogenous feed demand (RB), and a portion of the nutrient supply/demand (RF) are determined.

This model utilizes three different regional definitions. The first and primary set of regions consists of 105 producing areas (Figure 5). These areas are the basic regions for crop production. Therefore, the land availability and irrigation sectors are also defined at this level. The second set of regions is the 31 livestock producing regions (Figure 6). From these regions, livestock production is defined. In addition, these 31 regions serve as transportation and input purchase hubs. Transportation routes are defined from one market region to another. The final set of regions consists of 34 ecosytems. Range and pasture production activities are defined at this level.

Constraint Type	Row Type	RHS	XDPAx	XISPAx	XIGPAx	XLPPAx	XMDICPAx	XMIDCPAx	XMWETPAx	XWASPAx	XWAGPAx	XWBPAx	XWOPAx	XDPAy	XISPAy	XIGPAy	XLPPAy	XMDICPAy	XMIDCPAy	XMWETPAy	XWASPAy	XWAGPAy	XWBPAy	XWOPAy	XAMRz	XBMRz	XEMRz	XFMRz	XJMRz	XTAMRz MRv	XTCMRz MRv	XGECq
Objective Fn.			CD	CI	CI	CLP	CMDIC	0.01	CMWET	CWA	CWA			CD	CI	CI	CLP	CMDIC	0.01	CMWET	CWA	CWA			CA		CE	CF	CJ	CTA	CTC	CG
Total Irr. Land	G	RLIN		1	1										1	1																	
Nat. Crop Demand	G	RDCN	YD	YI	YI									YD	YI	YI																	
Export Demands	G	REX																										1					
Total Range	L	RPRT																														YG
Graze Land	L	RLG				-PLR											-PLR															1
Erosion (SSED)	N	0																														SSED
Total Land (x)	G	0	1	1	1																											
Dry Land (x)	L	RLDY(x)	1			PLR	-PDRY	PIRR (+-1)																								
Irr. Land (Surf) (x)	L	RLIR(x)		1			PDRY	-PIRR																								
Irr. Land (Grnd) (x)	L	RLIR(x)			1		PDRY	-PIRR																								
Cons. Till Max (x)	L	RLCTL(x)	0,1	0,1	0,1																											
Zero Till Max (x)	L	RLZTL(x)	0,1	0,1	0,1																											
Irr. Land Req. (x)	G	RLIT(x)		1	1																											
Irr. Needs (Surf) (x)	L	0		WR						-WEI																						
Irr. Needs (Grnd) (x)	L	0			WR						-WEI																					
Surf. Water Supply (x)	L	RWS(x)								1		(+-1)(+-1)																				
Erosion (S&R) (x)	N	0	SWTD	SWTI	SWTI																											
Erosion (Wind) (x)	N	0	SWDD	SWDI	SWDI																											
Total Land (y)	G	0												1	1	1																
Dry Land (y)	L	RLDY(y)												1			PLR	-PDRY	PIRR (+-1)													
Irr. Land (Surf) (y)	L	RLIR(y)													1			PDRY	-PIRR													
Irr. Land (Grnd) (y)	L	RLIR(y)														1		PDRY	-PIRR													
Cons. Till Max (y)	L	RLCTL(y)												0,1	0,1	0,1																
Zero Till Max (y)	L	RLZTL(y)												0,1	0,1	0,1																
Irr. Land Req. (y)	G	RLIT(y)													1	1																
Irr. Needs (Surf) (y)	L	0													WR						-WEI											
Irr. Needs (Grnd) (y)	L	0														WR						-WEI										
Surf. Water Supply (y)	L	RWS(y)																			1		(+-1)(+-1)									
Erosion (S&R) (y)	N	0												SWTD	SWTI	SWTI																
Erosion (Wind) (y)	N	0												SWDD	SWDI	SWDI																
Fertilizer (z)	L	RF	FD	FI	FI									FD	FI	FI									-FA			-1				
Terrace Min. (z)	G	RLTBR(z)	0,1	0,1	0,1									0,1	0,1	0,1																
Crop Acreage (z)	G	RLCRP(z)	WTC	WTC	WTC									WTC	WTC	WTC																
Final Demands (Crop) (z)	G	RDC(z)	YD	YI	YI									YD	YI	YI										-1	-1		-1		(+-1)	
Final Demands (Live) (z)	G	RDL(z)																							YA		-1			(+-1)		
Inter. Demands (Live) (z)	G	0																							YA,NA					(+-1)		
Exog. Feed Demands (z)	G	RB(z)																								1						
Pasture Demands (z)	L	RPR(z)																											1			-YG
Nutrient Needs (z)	G	0																							JA				JS			
Roughage Cons. (z)	G	0																							MINR,MAXR							
Bounds						BND	BND										BND	BND														

Note: 0,1 indicates that either value can occur depending on the activity type
(+-1) indicates that either a +1 or a -1 can be placed in these cells depending on the activity flow

Figure 4. A schematic of the Agricultural Resource Interregional Modelling System's programming model

Table 21. Description of variables used in the mathematical expression of the model

Variable Name	Variable Description
$CA_{p,q}$	is the per unit cost of livestock production in market region (p) for livestock type (q) (dollars per cwt. of primary product)
$CD_{i,j,k,m}$	is the cost of dryland cropping practices in producing area (i), on land group (j), rotation (k), employing tillage practice (m) (dollars per acre)
$CE_{p,c}$	is the cost of exporting commodity (c) from Great Lakes Region to the east coast market regions (p) (7,10, and 11) (dollars per unit)
CF_{p}	is the per unit cost of fertilizer in market region (p) (dollars per pound)
$CG_{e,f,g,h}$	is the per unit cost of forage production in ecosystem (e), productivity class (f), condition class (g), with management strategy (h) (dollars per acre)
$CI_{i,j,k,m,w}$	is the cost of dryland cropping practices in producing area (i), on land group (j), rotation (k), employing tillage practice (m) (dollars per acre)
$CJ_{p,n,v}$	is the per unit cost of feeding crop (n) for livestock type (v) in market region (p) (dollars per unit)
$CLP_{i,r}$	is the cost of converting potential crop land in producing area (i) and conversion type (r) (dollars per acre)
$CMDIC_{i,j}$	is the cost of converting an acre of non-irrigated land to irrigated land in producing area (i) on land group (j)
$CMWET_{i}$	is the cost of converting an acre of wetlands to non-irrigated cropland in producing area (i)
$CTA_{t,u}$	is the per unit cost of transporting endogenous commodity (u) over transportation route (t) (dollars per hundred weight)

Table 21 (Continued)

Variable Name	Variable Description
$CTC_{t,n}$	is the per unit cost of transporting endogenous commodity (n) over transportation route (t) (dollars per unit)
$CWA_{i,w}$	is the cost per acre foot of applying water source (w) in producing area (i) (dollars per acre-foot)
$FA_{p,q}$	is the amount of manure (expressed in nitrogen equivalents) produced in market region (p) by livestock type (q)
$FD_{i,j,k,m}$	is the amount of nitrogen required by a dryland cropping practice in producing area (i), land group (j), rotation (k), and conservation tillage practice (m) (pounds)
$FI_{i,j,k,m,w}$	is the amount of nitrogen required by a dryland cropping practice in producing area (i), land group (j), rotation (k), using irrigation type (w) and conservation tillage practice (m) (pounds)
$JA_{p,q,z}$	is the amount of nutrient (z) required by the livestock production activity type (q) in market region (p)
$JJ_{p,n,u,z}$	is the amount of nutrient (z) supplied by one unit of commodity (n) to major livestock type (u) in market region (p)
$MAXR_{u}$	is the maximum percent roughage that can occur in the ration and maintain the level of yield for livestock type (u)
$MINR_{u}$	is the minimum percent roughage that can occur in the ration and maintain the level of yield for livestock type (u)
$NA_{p,q,u}$	is the amount of replacement stock required of major livestock type (u) for livestock production activity (q) in market region (p)
$PDRY_{i,j}$	is the percent of dryland in land group (j) and producing area (i) that is converted when one dryland acre is converted to irrigated land
$PIRR_{i,j,w}$	is the percent of irrigated land using source (w) in land group (j) and producing area (i) that is converted when one dryland acre is converted to dry land

Table 21 (Continued)

Variable Name	Variable Description
$PLR^{e}_{i,j,r}$	is the percent of land in ecosystem (e) having potential of (r) in producing area (i) and land group (j)
$RB_{p,b}$	is the amount of feed required by the exogenous livestock in market region (p) for feed type (b)
$RDC_{p,n}$	is the amount of commodity (n) demanded in market region (p)
$RDCN_{n}$	is the amount of crop commodity (n) demanded at a national level [This RHS value exists only for those crops with no transportation network]
$RDL_{p,u}$	is the amount of livestock commodity (u) demanded in market region (p)
$REX_{s,c}$	is the level of exports for commodity (c) in exporting region (s)
RF_{p}	is the level of fertilizer available (required) by exogenous agriculture in market region (p)
$RLCRP_{n,p}$	is the amount of land that is planted in crop (n) in market region (p)
$RLCTL_{i}$	is the maximum quantity of land available for conservation tillage cropping practices in producing area (i)
$RLDY_{i,j}$	is the amount of land available for endogenous dryland cropland production in land group (j) and producing area (i)
$RLG_{e,f,g}$	is the quantity of grazing land in ecosystem (e), productivity class (f), and condition class (g)
RLIN	is the minimum number of acres irrigated
$RLIR_{i,j,w}$	is the amount of land available for endogenous irrigated cropland production in land group (j) and producing area (i)
$RLIT_{i,w}$	is the minimum level of irrigated acres in producing area (i) using water source (w)
$RLTER_{p}$	is the amount of land required to be in terraces in market region (p)

Table 21 (Continued)

Variable Name	Variable Description
$RLTOT_i$	is the total amount of land required to come into solution in producing area (i)
$RLZTL_i$	is the amount of zero or no tillage that can come into the solution in producing area (i)
$RWS_{i,w}$	is the quantity of water available in producing area (i), and source of water (w)
RPR^a_p	is the quantity of pasture available in market region (p) and ownership category (a) [when the grazing sector is endogenous and a = 1, this value is 0]
RPRT	is the maximum amount of tons from the range sector
$SWDD_{i,j,k,m}$	is the per acre wind erosion coefficient for dryland farming in producing area (i), land group (j), rotation (k), and conservation tillage practice (m)
$SWDI_{imj,k,m,w}$	is the per acre wind erosion coefficient for irrigated land farming in producing area (i), land group (j), rotation (k), and conservation tillage practice (m)
$SWTD_{i,j,k,m}$	is the per acre sheet and rill erosion coefficient for dryland farming in producing area (i), land group (j), rotation (k), and conservation tillage practice (m)
$SWTI_{i,j,k,m,w}$	is the per acre sheet and rill erosion coefficient for irrigated land farming in producing area (i), land group (j), rotation (k), and conservation tillage practice (m)
$WEI_{i,w}$	is the incidental efficiency of water for producing area (i) and source of water (w)
$WEO_{i,w}$	is the on-farm water efficiency for producing area (i) and source of water (w)
$WR_{i,k,w}$	is the water requirement for producing area (i), rotation (k), and source of water (w)
$WTC_{n,i,j,k,m}$	is the percentage of crop (n) in producing area (i), land group (j), rotation (k), and conservation tillage practice (m)
$XA_{p,q}$	is the activity level of livestock production type (q) in market region (p)

Table 21 (Continued)

Variable Name	Variable Description
$XB_{p,n}$	is the activity level to transfer crop (n) so that exogenous livestock needs can be met in market region (p)
$XD_{i,j,k,m}$	is the activity level of dryland crop production in producing area (i), land group (j), rotation (k), and conservation/tillage practice (m)
$XE_{p,c}$	is the amount of commodity (c) transferred from the market region (p) final demand constraints to the exporting regions
XF_{p}	is the level of the nitrogen purchasing activity in market region (p)
$XG_{e,f,g,h}$	is the level of the range activity in ecosystem (e), productivity class (f), condition class (g), under management level (h)
$XI_{i,j,k,m,w}$	is the activity level of irrigated land crop production in producing area (i), land group (j), rotation (k), and conservation/tillage practice (m)
$XJ_{p,n,q}$	is the level of crop (n) used for major endogenous livestock type (q) in market region (p)
$XLP_{i,r}$	is the quantity of potential land type (r) in producing area (i) that is converted to cropland
$XMDIC_{i,w}$	is the quantity of land converted from dry to irrigation source (w) in producing area (i)
$XMIDC_{i,w}$	is the quantity of land converted from land with irrigation source (w) to dry in producing area (i)
$XMWET_{i}$	is the quantity of cropland classified as a W soil (Land Group 7) and converted to RCA Land Group 1 soil through drainage
$XTA_{t,u}$	is the amount of major livestock type (u) transported on route (t) with a superscript I indicates an Import into a region, with an E it is an Export
$XTC_{t,n}$	is the amount of crop (n) transported on route (t) with a superscript I indicates an Import into a region, with an E it is an Export

Table 21 (Continued)

Variable Name	Variable Description
$XWA_{i,w}$	is the amount of water applied in producing area (i) from source (w)
$XWE_{i,d}$	is the amount of water exported in producing area (i) to destination (d)
$XWO_{i,d}$	is the amount of water outflow in producing area (i) to destination (d)
$YA_{p,q,u}$	is the yield for major livestock type (u) in livestock category (q) in market region (p)
$YD_{n,i,j,k,m}$	is the dryland yield for crop (n) in producing area (i), land group (j), rotation (k), and tillage practice (m)
$YG_{p,e,f,g,h}$	is the proportion of pasture/range yield in market region (p) that is in ecosystem (e), productivity class (f), condition class (g), under range management practice (h)
$YI_{n,i,j,k,m,w}$	is the irrigated yield for crop (n) in producing area (i), land group (j), rotation (k) and tillage practice (m), water source (w)

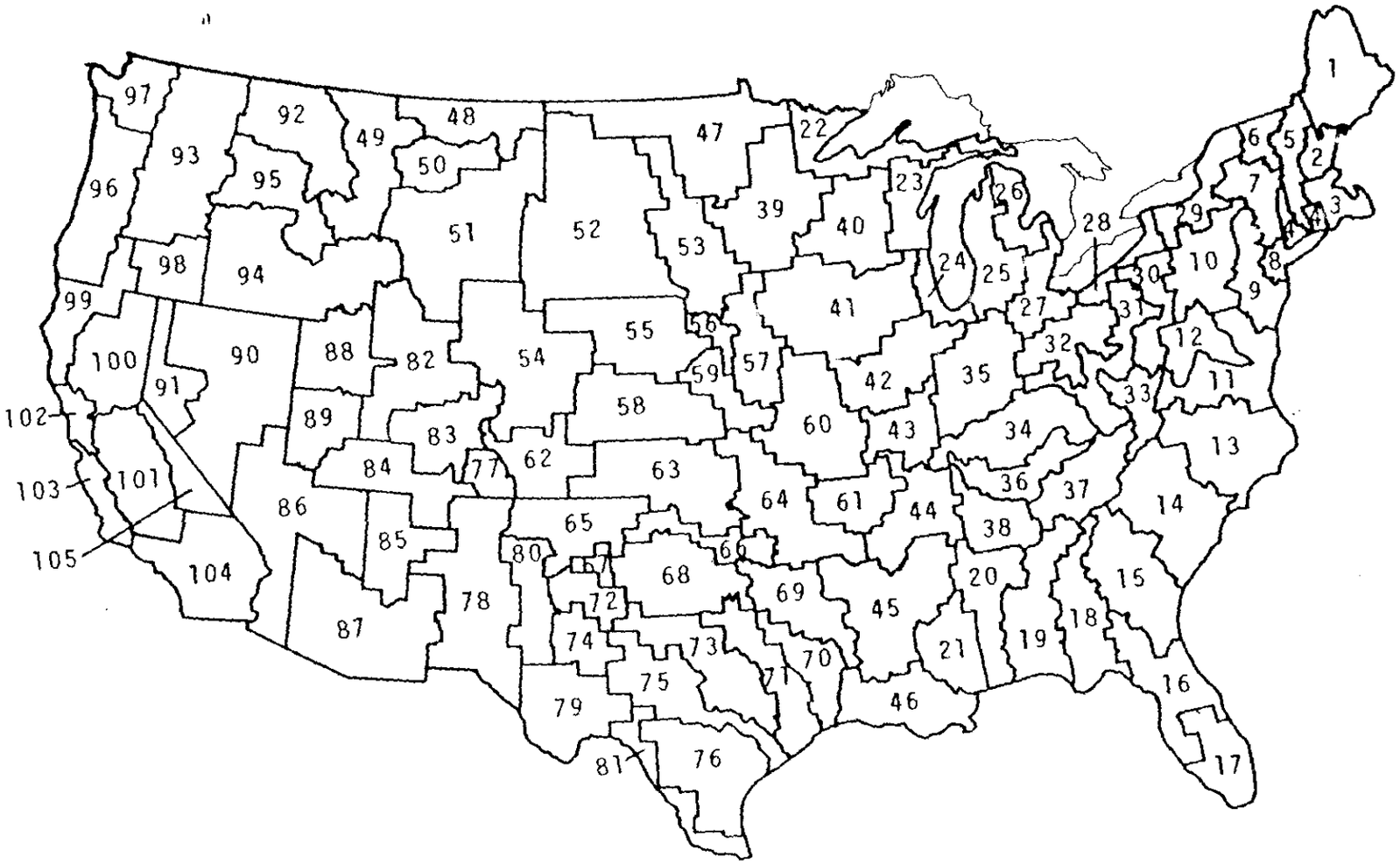

Figure 5. The 105 producing areas (CPA)

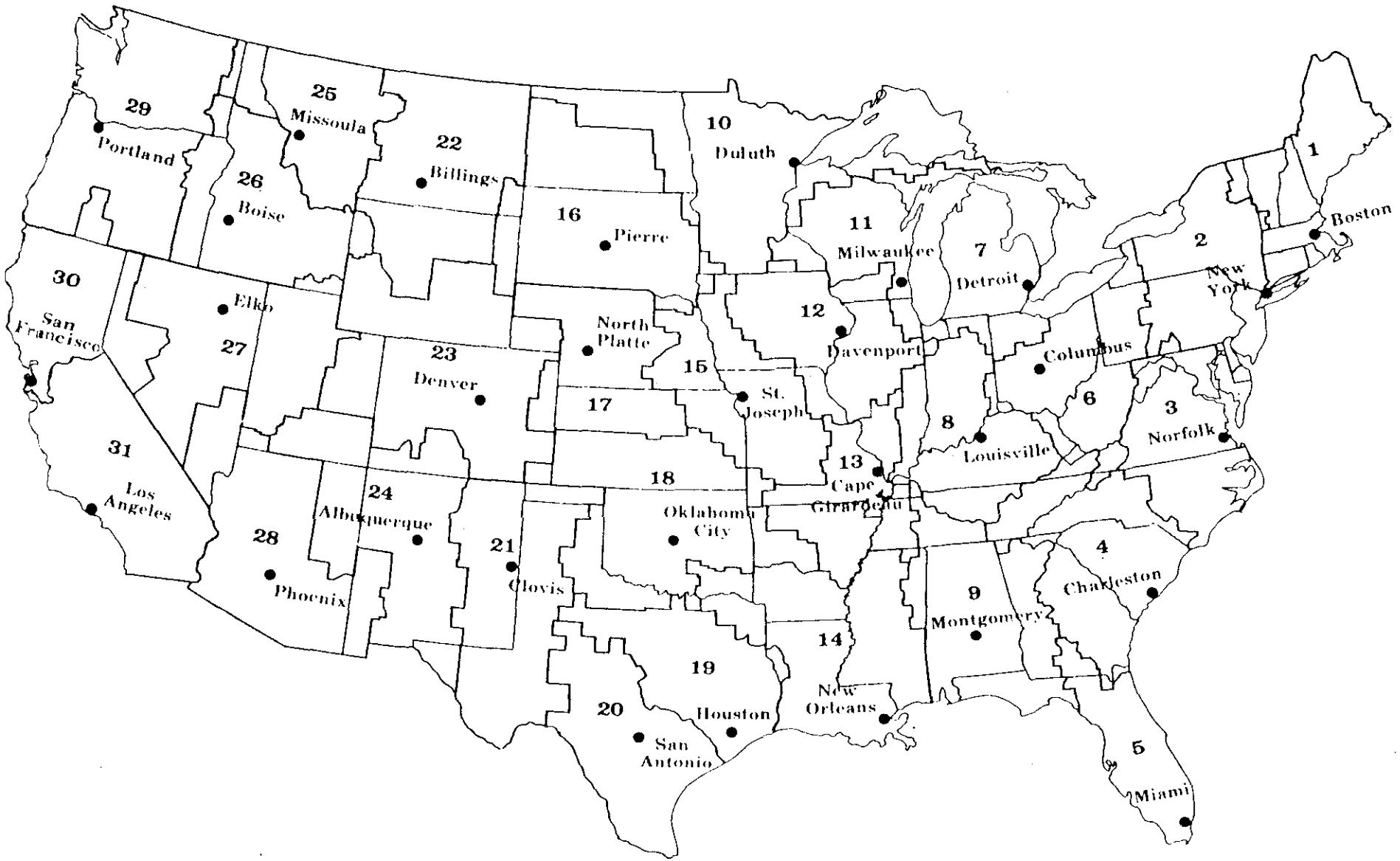

Figure 6. The 31 Livestock Producing Areas (LPA)

Mathematical Description of ARIMS

The presentation of the equations is divided into two sections, the objective function and the constraints. The equations use the same nomenclature as the schematic. Table 21 describes the variables used in the equations. Generally, activities are identified as starting with an X and levels of constraints begin with an R. Coefficients in the objective function begin with the letter C. Those coefficients that are documented in this manuscript are in bold type.

The Objective function:

$$OBJ = \sum_{i=1}^{105}\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=1}^{16}(CD_{i,j,k,m} * XD_{i,j,k,m})$$

Crop Sector

$$+ \sum_{i=1}^{105}\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=1}^{16}\sum_{w=1}^{2}(CI_{i,j,k,m,w} * XI_{i,j,k,m,w})$$

$$+ \sum_{i=1}^{105}\sum_{w=1}^{2}(CWA_{i,w} * XWA_{i,w} * (WEO_{i,w}/WEI_{i,w}))$$

Water Sector

$$+ \sum_{e=10}^{44}\sum_{f=1}^{4}\sum_{g=1}^{3}\sum_{h=1}^{90}(CG_{e,f,g,h} * XG_{e,f,g,h})$$

Range/ Forest Sector

$$+ \sum_{p=1}^{31}\sum_{q=1}^{14}(CA_{p,q} * XA_{p,q})$$

Livestock Sector

$$+ \sum_{p=1}^{31}\sum_{n=1}^{16}\sum_{v=1}^{5}(CJ_{p,n,v} * XJ_{p,n,v})$$

$$+ \sum_{i=1}^{105} \sum_{r=1}^{4} (CLP_{i,r} * XLP_{i,r})$$

$$+ \sum_{i=1}^{105} \sum_{w=1}^{2} (0.01 * XMIDC_{i,w})$$

Land Conversion Sector

$$+ \sum_{i=1}^{105} \sum_{w=1}^{2} (CMDIC_{i,j} * XMDIC_{i,w})$$

$$+ \sum_{i=1}^{105} (CMWET_{i} * XMWET_{i})$$

$$+ \sum_{p=1}^{31} (CF_{p} * XF_{p})$$

Fertilizer Sector

$$+ \sum_{t=1}^{967} \sum_{n=1}^{16} (CTC_{t,n} * XTC_{t,n})$$

$$+ \sum_{t=1}^{967} \sum_{u=1}^{6} (CTA_{t,u} * XTA_{t,u})$$

Transportation Sector

$$+ \sum_{c=1}^{10} \sum_{p=7,10,11} (CE_{p,c} * XE_{p,c})$$

Constraints

Fertilizer constraints (market region):

$$\sum_{i \in p} \sum_{j=1}^{8} \sum_{k=1}^{k} \sum_{m=1}^{16} (FD_{i,j,k,m} * XD_{i,j,k,m} + \sum_{w=1}^{2} (FI_{i,j,k,m,w} * XI_{i,j,k,m,w})) - \sum_{q=1}^{14} (FA_{p,q} * XA_{p,q}) - XF_p \leq RF_p$$

Water sector constraints (producing area):

$$\sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=1}^{12} ((XI_{i,j,k,m,w} * WR_{i,k,w}) - (WEI_{i,w} * XWA_{i,w})) \geq 0.0$$

when w=1, XWA_i is unconstrained

when w=2:

$$XWA_{i,2} + \sum_{d=1}^{D} XWE_{i,d} + \sum_{d=1}^{D} XWO_{i,d} \leq RWS_{i,2}$$

Erosion accounting rows:

Sheet and rill erosion (producing area):

$$\sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=1}^{16} (SWTD_{i,j,k,m} * XD_{i,j,k,m} + \sum_{w=1}^{2} (SWTI_{i,j,k,m,w} * XI_{i,j,k,m,w})) \geq 0.0$$

Wind erosion (producing area):

$$\sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=1}^{16} (SWDD_{i,j,k,m} * XD_{i,j,k,m} + \sum_{w=1}^{2} (SWDI_{i,j,k,m,w} * XI_{i,j,k,m,w})) \geq 0.0$$

Land constraints:

Total land constraint (producing area):

$$\sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=1}^{16} (XD_{i,j,k,m} + \sum_{w=1}^{2} (XI_{i,j,k,m,w})) \geq RLTOT_i$$

Dryland constraint (producing area):

$$\sum_{k=1}^{K} \sum_{m=1}^{16} XD_{i,j,k,m} - (PDRY_{i,j} * XMDIC_i) + \sum_{w=1}^{2} (PIRR_{i,j,w} * XMIDC_{i,w}) + \sum_{r} PLR^{e}_{i,j,r} * XLP_{i,r} \leq RLDY_{i,j}$$

Irrigated land constraint (producing area):

$$\sum_{k=1}^{K} \sum_{m=1}^{16} XI_{i,j,k,m,w} + (PDRY_{i,j} * XMDIC_i) - (PIRR_{i,j,w} * XMIDC_{i,w}) \leq RLIR_{i,j,w}$$

Conservation tillage land constraint (producing area):

$$\sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=9}^{12} \sum_{w=1}^{2} (XD_{i,j,k,m} + XI_{i,j,k,m,w}) \leq RLCTL_i$$

Zero tillage land constraint (producing area):

$$\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=13}^{16}\sum_{w=1}^{2}(XD_{i,j,k,m} + XI_{i,j,k,m,w}) \leq RLZTL_i$$

Terraced land constraint (market region):

$$\sum_{i\epsilon p}\sum_{j=bb}\sum_{k=1}^{K}\sum_{m=aa}\sum_{w=1}^{2}(XD_{i,j,k,m} + XI_{i,j,k,m,w}) \geq RLTER_p$$

where:

aa = 4,8,12,16

bb = 2,3,4,8

Required irrigation land constraint (producing area):

$$\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=1}^{16} XI_{i,j,k,m,w} \geq RLIT_{i,w}$$

Total irrigation land constraint (national):

$$\sum_{i=1}^{105}\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=1}^{16}\sum_{w=1}^{2} XI_{i,j,k,m,w} \geq RLIN$$

Crop acreage constraint (market region):

$$\sum_{i\epsilon p}\sum_{j=1}^{8}\sum_{k=1}^{K}\sum_{m=1}^{16}(WTC_{n,i,j,k,m} * XD_{i,j,k,m} + \sum_{w=1}^{2}(WTC_{n,i,j,k,m} * XI_{i,j,k,m,w})) \geq RLCRP_{n,p}$$

Grazing land constraint (ecosystem):

$$\sum_{h} XG_{e,f,g,h} + \sum_{i \in e} PLR^{e}_{i,j,r} * XLP_{i,r} \leq RLG_{e,f,g}$$

Final Demands:

Crop (market region):

$$\sum_{i=1}^{105} \sum_{j=1}^{8} \sum_{k=1}^{K} \sum_{m=1}^{16} (YD_{n,i,j,k,m} * XD_{i,j,k,m} + \sum_{w=1}^{2} (YI_{n,i,j,k,m,w} * XI_{i,j,k,m,w})) - XE_{p,c} - XB_{p,n} + XTC^{I}_{t,n} - XTC^{E}_{t,n} - \sum_{u=1}^{7} XJ_{n,p,u} \geq RDC_{p,n}$$

Crop (national):

$$\sum_{p=1}^{31} XCT_{p,n} \geq RDCN_{n}$$

Dairy (market region):

$$(YA_{p,1,1} * XA_{p,1}) + XTA^{I}_{t,1} - XTA^{E}_{t,1} - XE_{p,7} \geq RDL_{p,1}$$

Pork (market region):

$$\sum_{q=2}^{3} (YA_{p,q,2} * XA_{p,q}) + (YA_{p,4,2} * XA_{p,4}) + XTA^{I}_{t,2} + XTA^{E}_{t,2} - XE_{p,8} \geq RDL_{p,2}$$

Grain fed beef (market region):

$$\sum_{q=8}^{12} (YA_{p,q,3} * XA_{p,q}) + XTA^{I}_{t,3} - XTA^{E}_{t,3} - XE_{t,3} \geq RDL_{p,3}$$

Roughage fed beef (market region):

$$\sum_{q=13}^{14} (YA_{p,q,4} * XA_{p,q}) + (YA_{p,1,4} * XA_{p,1}) + \sum_{q=5}^{7} (YA_{p,q,4} * XA_{p,q}) + XTA^{I}_{t,4} - XTA^{E}_{t,4} - XE_{t,4} \geq RDL_{p,4}$$

Intermediate Demands:

Feeder pigs (market region):

$$\sum_{q=2,4} (YA_{p,q,7} * XA_{p,q}) - \sum_{q=2}^{3} (NA_{p,q,7} * XA_{p,q}) \geq 0.0$$

Calves and yearlings (market region):

$$\sum_{q=5}^{7} (YA_{p,q,u} * XA_{p,q}) + (YA_{p,1,1} * XA_{p,1}) - \sum_{q=8}^{14} (NA_{p,q} * XA_{p,q}) + XTA^{I}_{p,u} - XTA^{E}_{p,u} \geq 0.0$$

Export Demands (export region):

$$\sum_{p \in s} XE_{p,c} \geq REX_{s,c}$$

where:
when: s=1, p=1,2,3,4,5,7,10,11
s=2, p=9,14,19
s=3, p=29,30,31

Exogenous Feed Demands (market region):

$$\sum_{n \in b} XB_{p,b} \geq RB_{p,b}$$

where:
when: b=1, n=1,2,3,7,10,11
b=2, n=12
b=3, n=3,5,6,11

Pasture Demands:

Private (grazing sector exogenous):

$$\sum XJ^{a}_{p,8,u} \leq RPR^{a}_{p}$$

Private (grazing sector endogenous):

$$\sum XJ^{a}_{p,8,u} - \sum_{e=10}^{44} \sum_{f=1}^{3} \sum_{g=1}^{4} \sum_{h=1}^{90} (YG_{p,e,f,g,h} * XG_{e,f,g,h}) \leq RPR^{a}_{p}$$

Nutrient Needs (market region):

$$\sum_{n=1}^{16} (JJ_{p,n,v,z} * XJ_{p,n,v} - JA_{p,q,z} * XA_{p,q}) \geq 0.0$$

Roughage Constraints (market region):

$$\sum_{n=1,2,7,10,12,15,16} XJ_{n,p,q} * (1-MINR_u) - \sum_{n=3,5,6,8,9,11,14} XJ_{n,p,q} * (MINR_q) \geq 0.0$$

$$\sum_{n=1,2,7,10,12,15,16} XJ_{n,p,q} * (1-MAXR_u) - \sum_{n=3,5,6,8,9,11,14} XJ_{n,p,q} * (MAXR_q) \geq 0.0$$

Maximum Range Allowable Constraint (national):

$$\sum_e \sum_f \sum_g \sum_h (XG_{e,f,g,h} * \sum_p YG_{p,e,f,g,h}) \leq RPRT$$

a = 1,2 for the two pasture/range ownership categories (1 = private and 2 = public)

b = 1,...,3 for the three exogenous crop categories

c = 1,...,6 crop and 7,...,10 livestock exporting activities

d = 1,... destinations of water outflows and exports

e = 10,....,44 ecosystems

f = 1,...,4 Range/Forest productivity classes

g = 1,....,3 Range/Forest condition classes

h = 1,....,90 Range/Forest strategies management

i = 1,....,105 crop production areas

j = 1,....,8 land groups

k = 1,....,500 single crop and 509,....,516 double crop rotation sequences

m = 1,....,12 conservation tillage possibilities

n = 1,....,16 endogenous crops

p = 1,....,31 market regions

q = 1,....,14 livestock types

r = 1,....,4 potential land conversion activities

s = 1,...,3 for the three exporting regions

t = 1,....,967 transportation routes

u = 1,...,7 for the seven major livestock production categories: dairy, pork, grain-fed beef, roughage-fed beef, calves, yearlings, and feeder pigs

v = 1,....,5 for five livestock production categories: dairy, pork, cow/calf/yearling, grain-fed beef, and roughage-fed beef

w = 1,2 water source

z = 1,...,6 for the six nutrient types

CHAPTER III. FULLY EXOGENOUS LIVESTOCK MODEL (FELM)

An exogenous livestock sector is needed when the problem being analyzed does not require the detailed information provided by an endogenized livestock sector, when computer budgetary funds restrict the size of the model, or when, for whatever reason, the analyst decides that the use of an endogenous livestock sector is not necessary to the analysis. An exogenous livestock sector should be capable of: 1) reflecting livestock feed demands for feedgrains, concentrates and roughages, and 2) providing an estimate of livestock demands for water and supply of nitrogen fertilizer without the addition of a large number of rows and columns to the model matrix.

Variables of importance in an exogenous livestock sector include estimates of livestock product demands, feed demands, water demands and nitrogen supplies. Product demands include beef, pork, mutton, turkey, poultry, eggs and dairy products. Feed demands include feedgrains and concentrates such as barley, corn, oats, sorghum, wheat and oilmeals and roughages such as legume and nonlegume hay, silage and pasture. Data for regional product demands are converted to feed demands through a set of rations, water demands through a set of water use coefficients and nitrogen supplies through a procedure developed at the Center for Agricultural and Rural Development by Short and Dvoskin (1982).

The remainder of this chapter presents the methodology employed in estimating feed needs, water needs, and manure supplies. Requirements for livestock feed calculations include:

1. Projected production levels;
2. Current average consumption of concentrates by concentrate type and livestock;
3. Current average consumption of roughages by roughage type and livestock;
4. Feed efficiency adjustments for the years 1990, 2000, and 2030; and
5. Coefficients which allow substitution of one feedgrain to another within the fixed ration.

Water and manure coefficients are also presented.

Finally, much of the exogenous livestock sector work was completed in 1982. This work was developed prior to the latest projection information and the latest census. Thus, adjustments required for the Resource Conservation Act are made in the development of the final coefficients and not in the initial steps. Most of the data in this chapter reflect 1970 and early 1980 conditions.

Development of Rations

Feed for livestock can be categorized into three types—feed grain concentrates, other concentrates, and roughages. The concentrates category consists of feedgrains, barley, corn, oats, and sorghum, wheat, oilmeals, animal proteins (ie. bloodmeal), grain proteins (ie. wheat middlings), and milkfeeds. Roughages consist of hays, silages, and pastures.

The portion of the ration that is derived from feedgrain concentrates and other concentrates are placed into two constraints at the market region level ($RB_{1,p}$ and $RB_{2,p}$). Unfortunately, the data required to get the level of feed for these two constraints are not

available by market region. One must use more aggregated data and disaggregate based on weighting schemes (Figure 7). Total feed feed concentrate consumption is available at the ten USDA production regions (Figure 8) based on unpublished data provided by Allen (1980). These estimates are available per the period 1967-1968 through 1976-1977 feeding years. The more aggregated United States data are presented in Tables 22 through 30. These concentrate consumption values at the USDA region are then allocated to each state within that region based on data presented in various editions of Agricultural Statistics (United States Department of Agriculture, 1970, 1974, 1978, 1980).

Roughage requirements are determined for the ruminants beef, dairy, and sheep. The other livestock commodities are not expected to require roughage in their diet. The crop commodities included in the roughage category are legume hay, nonlegume hay, corn silage, and sorghum silage. Pasture requirements are not included in the ration as no information is available on the number of tons of pasture consumed by various livestock types. Unfortunately, the information on roughage fed to livestock is not as complete as the concentrate information. Up until 1974, information on roughages fed to livestock by state and type of livestock is available in Livestock-Feed Relationships (Allen and Devers, 1975). These data are not sufficiently current, however. The next step involved contacting George Allen of The Economic Research Service.[5] After discussing the problem, the authors found that he had estimates of total roughage consumed by livestock type and states. He did not have the roughage broken into the four categories—legume hay, other hay, corn silage, and sorghum silage. It was decided that this information

Figure 7. Schematic of the steps used in determining the exogenous feed rations

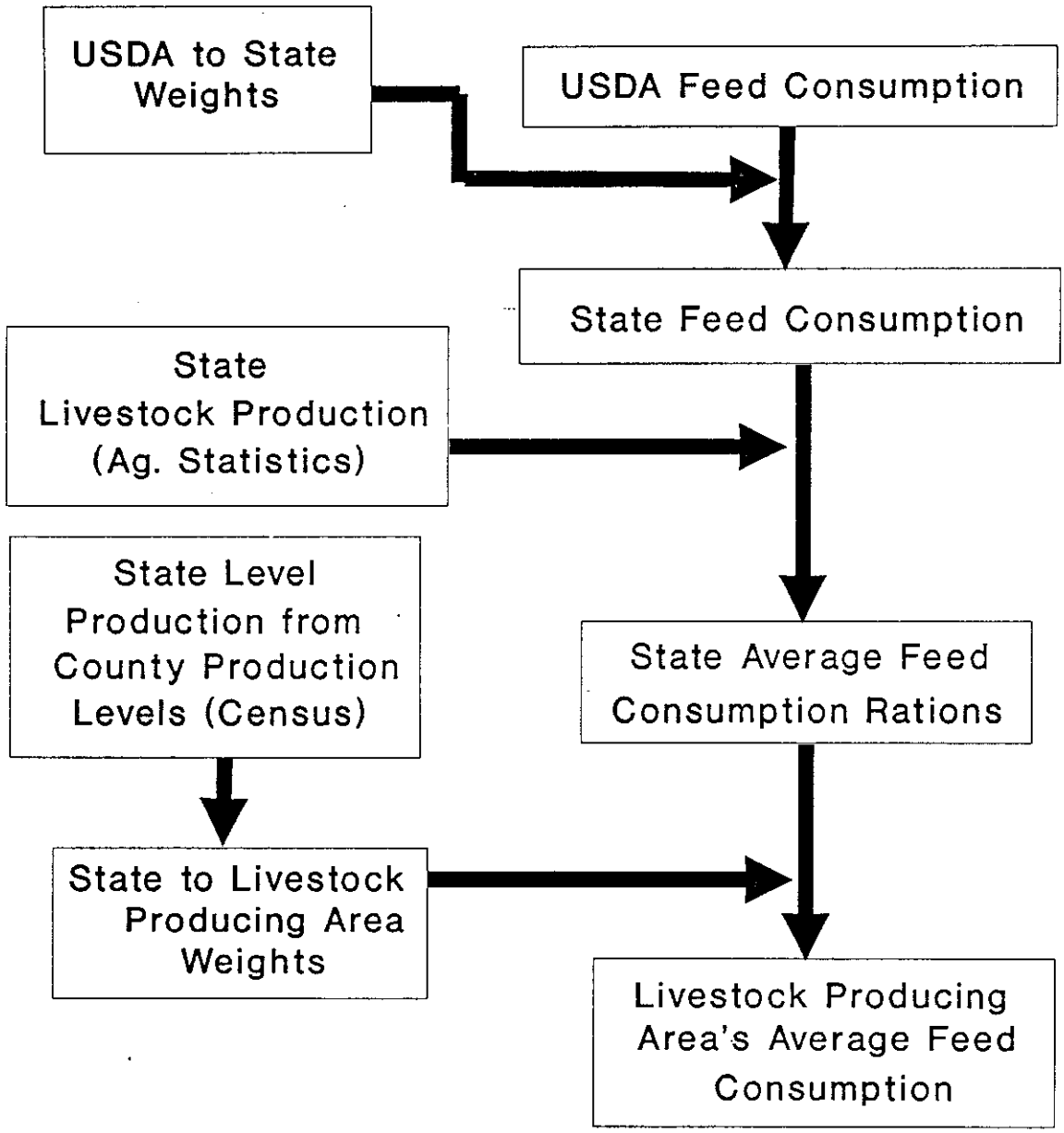

Figure 8. The USDA Farm Production Regions

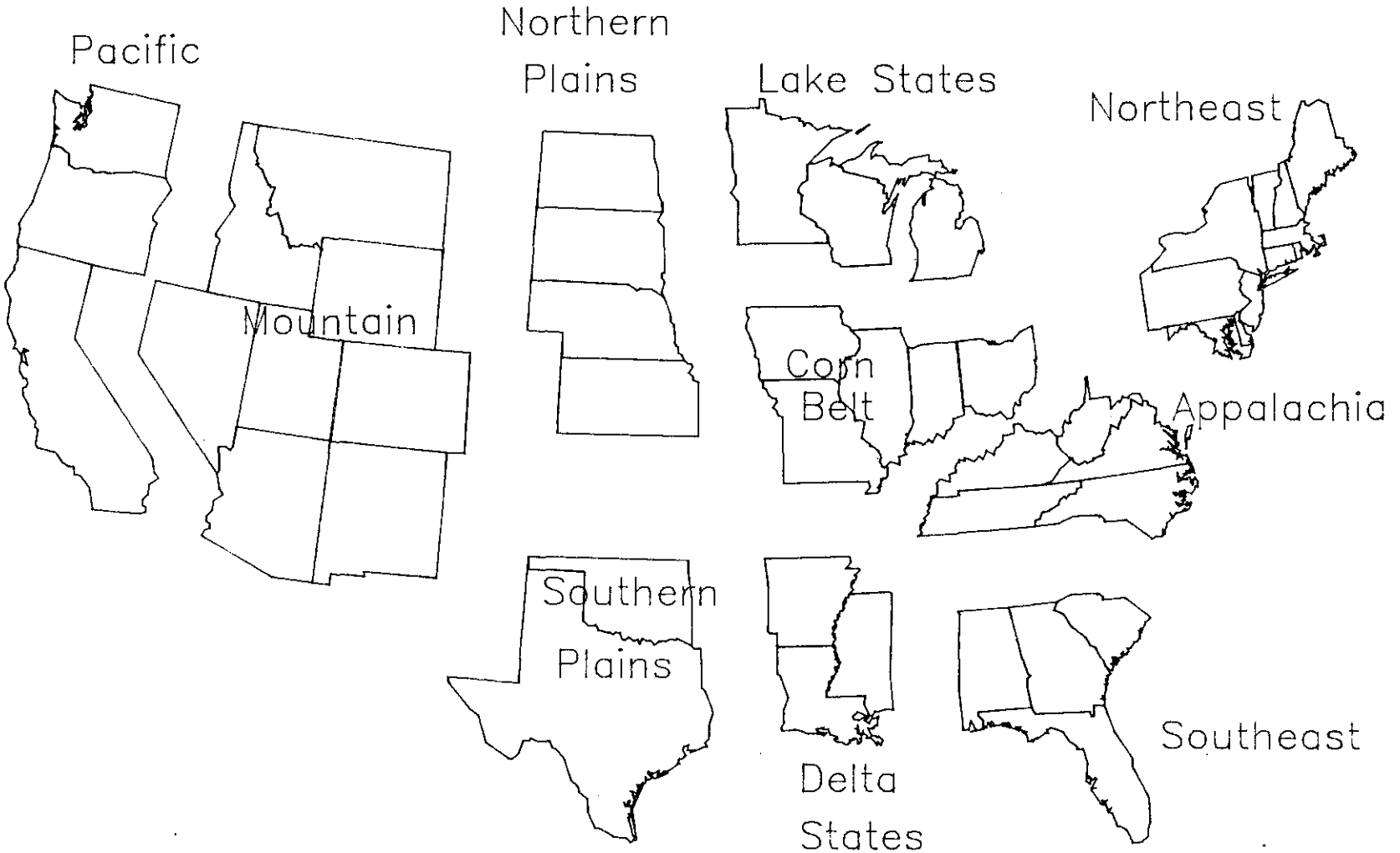

Table 22. Concentrates fed to livestock by type of concentrate, 1967 - 1968 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	15,083	477	3,233	1,277	424	0	1,514	0	598	923	869	1,123	792
Other Dairy	1,407	122	591	112	14	2	12	0	60	23	79	53	307
Cattle Feed	14,197	8,947	545	1,998	1,675	10	755	0	122	0	1,380	102	906
Other Beef	5,087	1,042	525	412	84	4	632	0	49	118	402	331	2,216
Stock Sheep	202	43	48	19	5	0	191	0	0	0	15	0	299
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,612	1,499	1,880	506	1,016	132	1,949	570	137	41	41	614	70
Chickens	1,014	474	369	88	347	5	542	159	56	0	0	16	4
Broilers	5,664	254	0	0	167	161	1,975	448	225	0	0	113	92
Turkeys	1,678	214	0	47	340	33	595	234	104	51	51	37	72
Hogs	34,001	1,473	730	609	472	64	3,699	518	126	272	272	425	459
Horses-Mules	1,025	159	2,144	64	0	0	23	0	0	47	47	84	1
Other Livestock	578	317	869	179	289	56	950	393	245	12	12	253	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 23. Concentrates fed to livestock by type of concentrate, 1969 - 1970 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	14,884	429	3,473	1,221	417	0	1,557	0	630	1,015	813	1,195	726
Other Dairy	1,539	121	676	120	16	2	14	0	67	27	84	60	321
Cattle Feed	21,221	12,298	913	2,795	2,336	17	1,275	0	206	0	1,886	189	1,400
Other Beef	5,891	1,038	749	460	92	5	762	0	61	160	439	426	2,517
Stock Sheep	218	42	60	19	6	0	218	0	0	0	15	0	322
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,680	1,398	2,060	498	1,011	139	2,022	615	145	1,046	40	660	68
Chickens	1,095	480	439	94	370	5	599	182	63	135	0	18	4
Broilers	6,593	288	0	0	195	191	2,328	546	275	0	0	141	106
Turkeys	1,829	213	0	48	366	40	687	286	124	1	52	46	74
Hogs	35,618	1,386	841	594	468	73	4,078	602	141	524	257	485	455
Horses-Mules	976	138	2,272	60	0	0	23	0	0	32	43	86	1
Other Livestock	470	233	790	136	247	50	821	358	216	228	9	227	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 24. Concentrates fed to livestock by type of concentrate, 1970 -1971 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	13,421	400	3,175	1,140	383	0	1,379	0	575	919	769	1,087	664
Other Dairy	1,401	110	620	111	15	2	12	0	62	24	78	55	294
Cattle Feed	19,210	11,821	836	2,624	2,173	15	1,147	0	192	0	1,794	174	1,288
Other Beef	5,880	1,071	765	477	93	5	748	0	61	161	459	429	2,546
Stock Sheep	222	44	62	20	6	0	220	0	0	0	16	16	332
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,599	1,433	2,085	514	1,018	133	1,967	586	144	1,040	42	42	69
Chickens	1,045	469	427	93	359	5	560	168	61	130	0	0	4
Broilers	6,726	298	0	0	200	188	2,327	539	280	0	0	0	111
Turkeys	1,851	224	0	51	375	38	677	275	126	2	56	56	77
Hogs	36,487	1,540	879	648	500	73	4,106	593	147	533	285	285	480
Horses-Mules	937	134	2,221	59	0	0	22	0	0	31	42	42	1
Other Livestock	504	267	873	156	270	51	858	365	234	243	10	10	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 25. Concentrates fed to livestock by type of concentrate, 1971 - 1972 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	14,291	389	3,351	1,149	392	0	1,493	0	599	988	765	1,155	702
Other Dairy	1,432	105	629	111	15	2	13	0	62	25	77	56	299
Cattle Feed	23,545	13,701	1,012	3,031	2,508	20	1,477	0	235	0	2,058	224	1,618
Other Beef	5,813	963	755	445	90	5	757	0	60	165	421	432	2,505
Stock Sheep	204	38	60	18	6	0	211	0	0	0	14	0	311
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,552	1,322	2,045	486	981	135	1,986	599	141	1,048	39	654	67
Chickens	1,039	431	418	88	343	5	563	170	59	131	0	18	4
Broilers	6,688	286	0	0	194	189	2,332	544	274	0	0	144	110
Turkeys	2,001	215	0	53	386	42	740	303	132	2	55	50	82
Hogs	33,958	1,266	804	552	432	69	3,894	571	133	509	238	465	431
Horses-Mules	971	129	2,335	59	0	0	23	0	0	34	41	88	1
Other Livestock	529	251	917	151	271	54	919	392	240	261	10	259	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 26. Concentrates fed to livestock by type of concentrate, 1972 - 1973 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	14,687	373	3,497	1,156	400	0	1,552	0	615	1,044	757	1,194	695
Other Dairy	1,338	95	591	102	15	2	12	0	58	24	71	52	273
Cattle Feed	26,466	15,673	1,133	3,339	2,797	24	1,740	0	271	0	2,264	264	1,820
Other Beef	6,674	1,051	878	496	101	6	882	0	69	195	462	498	2,751
Stock Sheep	190	32	58	16	6	0	204	0	0	0	12	0	282
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,305	1,185	1,988	455	945	134	1,956	598	137	1,043	35	637	61
Chickens	1,025	400	410	84	337	5	564	173	59	132	0	17	3
Broilers	6,667	265	0	0	192	193	2,353	555	274	0	0	143	99
Turkeys	2,119	208	0	55	405	46	796	331	140	2	56	53	82
Hogs	33,282	1,169	784	531	421	68	3,832	568	129	505	225	452	402
Horses-Mules	1,001	122	2,467	58	0	0	24	0	0	36	41	92	1
Other Livestock	573	263	1,021	162	295	60	1,008	433	261	290	10	284	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 27. Concentrates fed to livestock by type of concentrate, 1973 - 1974 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	15,556	410	3,584	1,231	438	0	1,662	0	653	1,094	789	1,232	663
Other Dairy	1,544	111	673	119	17	2	14	0	67	27	81	59	301
Cattle Feed	25,691	15,734	1,050	3,244	2,815	24	1,706	0	265	0	2,184	248	1,622
Other Beef	8,490	1,405	1,119	641	128	8	1,113	0	87	243	591	612	3,213
Stock Sheep	186	34	56	16	6	0	202	0	0	0	12	0	250
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,379	1,227	1,978	455	985	140	2,006	626	140	1,050	34	627	52
Chickens	971	374	387	78	331	5	542	171	56	125	0	16	3
Broilers	6,691	268	0	0	198	199	2,400	578	279	0	0	141	80
Turkeys	1,969	195	0	50	391	44	752	324	131	2	50	48	65
Hogs	32,784	1,177	744	525	429	69	3,786	574	127	488	218	427	343
Horses-Mules	1,035	130	2,560	61	0	0	25	0	0	37	42	93	1
Other Livestock	565	270	982	161	301	61	1,006	443	261	285	10	272	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 28. Concentrates fed to livestock by type of concentrate, 1974 - 1975 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	15,243	493	3,053	1,291	442	0	1,544	0	596	947	844	1,100	669
Other Dairy	1,583	119	651	125	16	2	14	0	66	26	86	58	312
Cattle Feed	12,470	8,904	366	1,737	1,538	10	722	0	111	0	1,186	91	676
Other Beef	6,783	1,246	777	535	103	6	842	0	65	174	504	443	2,533
Stock Sheep	217	47	49	20	5	0	207	0	0	0	16	0	297
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	7,743	1,339	1,559	447	947	121	1,760	532	120	859	35	526	50
Chickens	938	414	323	80	331	5	498	151	50	107	0	14	3
Broilers	5,813	258	0	0	178	169	2,042	483	232	0	0	115	70
Turkeys	1,851	226	0	52	374	37	646	262	110	2	53	39	62
Hogs	27,289	1,208	510	490	390	52	2,970	429	99	349	212	319	299
Horses-Mules	1,203	182	2,541	75	0	0	28	0	0	37	53	99	1
Other Livestock	468	268	638	147	252	49	786	340	203	202	10	199	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 29. Concentrates fed to livestock by type of concentrate, 1975 - 1976 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	15,294	466	3,426	1,312	445	0	1,572	0	632	1,015	858	1,178	715
Other Dairy	1,318	95	568	105	14	2	11	0	57	22	72	50	265
Cattle Feed	16,736	11,330	631	2,300	1,988	15	1,048	0	169	0	1,572	151	1,087
Other Beef	6,719	1,169	869	532	102	6	850	0	68	186	501	473	2,672
Stock Sheep	205	43	53	19	6	0	204	0	0	0	15	0	297
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,010	1,307	1,849	470	973	128	1,842	566	131	955	37	586	55
Chickens	1,074	467	428	94	375	5	576	177	61	133	0	18	3
Broilers	6,633	287	0	0	199	193	2,323	554	274	0	0	141	90
Turkeys	1,798	229	0	56	400	41	710	294	127	2	57	46	74
Hogs	33,146	1,392	752	604	470	66	3,695	542	130	468	262	431	408
Horses-Mules	1,053	152	2,444	66	0	0	25	0	0	35	47	92	1
Other Livestock	432	233	702	136	243	47	748	331	201	207	9	203	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

Table 30. Concentrates fed to livestock by type of concentrate, 1976 - 1977 feeding year

Livestock Type	Corn	Sorghum Grain	Oats	Barley	Wheat & Rye	Fats[1]	Oilseed Meal[2]	Animal Protein[3]	Grain Protein[4]	Milk-Feeds[5]	Molasses	Misc.[6]	Mineral Urea[7]
	(thousand tons)												
Milk Cows	15,335	495	3,508	1,386	462	0	1,548	0	634	1,022	916	1,193	765
Other Dairy	1,363	99	598	112	15	2	12	0	58	23	77	52	285
Cattle Feed	15,173	40,964	559	2,209	1,911	13	923	0	154	0	1,535	135	1,044
Other Beef	6,256	1,144	821	520	98	5	776	0	63	174	496	445	2,655
Stock Sheep	213	47	54	21	6	0	208	0	0	0	16	0	321
Sheep Feed	0	0	0	0	0	0	0	0	0	0	0	0	0
Hens-Pullet	8,263	1,436	1,972	516	1,038	125	1,853	560	134	1,000	41	614	63
Chickens	991	467	405	93	363	5	520	159	56	126	0	17	3
Broilers	8,003	361	0	0	244	216	2,704	633	322	0	0	173	123
Turkeys	1,965	241	0	59	410	38	685	278	125	3	61	46	79
Hogs	37,546	1,653	886	722	552	73	4,127	595	150	532	318	497	503
Horses-Mules	1,088	164	2,522	71	0	0	25	0	0	36	51	95	1
Other Livestock	489	277	817	163	275	49	823	356	226	234	11	233	0

Source: Unpublished material in Economic Research Service's files personal communication with George Allen, 1980)

[1] Stabilized animal fats
[2] Soybean, cottonseed, peanut, and linseed meals
[3] Fishmeal, meatmeal and tankage, poultry offal, feather meal, etc.
[4] Gluten feed and meal, brewers and distillers dried grains
[5] Byproducts from floor mills, wheat, rice, oats, and barley milling byproducts
[6] Includes bakery byproducts, hominy, etc.
[7] Includes salt, mineral, and urea

would be used only as a informal check when the final rations are reviewed.

The problem of estimating the roughage ration was approached using data readily available in Agricultural Statistics and Feed Situation reports. Tables 31 through 34 contain production data for alfalfa, other hay, corn silage, and sorghum silage by state. The Feed Situation reports contain information on what was fed to each of the three livestock types of concern—beef, dairy, and sheep (Table 35). Consumption of the two hay types and the silages are determined by multiplying the information provided in Table 32 times the rations and dividing by production. These estimates are distributed to livestock producing area in a manner similar to that used in developing the feed concentrates.

Feedstuffs Required for One Hundred Pounds of Beef

Concentrate feed consumption for the production of beef is determined at the USDA level by summing the feed consumed over three livestock categories—cattle feed, other beef, and other dairy. These data are weighted to the 48 contiguous states by using state beef production data (Table 36). Since cyclical variation occurs in the production of beef, feed consumption is also expected to vary over the cycle changes in culling and replacement rates could alter the rations fed in any given year, average beef production over an entire cycle 1968-1975 is employed.

Once feed consumption is available by state, then feed consumption per 100 pounds of liveweight beef production is calculated by dividing average state feed consumption by average beef production.[6] Adjustments

Table 31. Alfalfa and alfalfa mixtures production by state, 1970 - 1979

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Alabama	1	8	9	8	0	0	0	0	0	0	0
Arizona	4	1,230	1,186	1,269	1,424	1,419	1,378	1,449	1,365	1,071	1,024
Arkansas	5	165	221	186	163	130	174	153	197	179	183
California	6	6,451	6,897	7,188	6,902	6,785	6,608	6,600	6,669	5,941	6,300
Colorado	8	2,052	2,025	1,937	2,115	1,838	2,027	2,100	1,953	2,262	2,449
Connecticut	9	64	73	48	56	49	50	62	48	60	58
Delaware	10	22	17	20	22	21	21	21	21	22	26
Florida	12	0	0	0	0	0	0	0	0	0	0
Georgia	13	10	12	12	0	0	0	0	0	0	0
Idaho	16	3,520	3,342	3,267	3,608	3,885	3,811	3,621	3,852	4,050	3,631
Illinois	17	2,403	2,324	2,555	2,457	2,294	2,541	2,584	2,811	2,774	2,886
Indiana	18	1,308	1,305	1,214	1,169	1,067	1,260	1,200	1,386	1,408	1,248
Iowa	19	5,374	5,286	5,511	6,208	5,430	5,429	5,246	6,125	7,200	7,421
Kansas	20	2,588	3,245	3,569	3,812	2,729	2,793	2,750	3,182	2,900	3,500
Kentucky	21	624	693	564	583	591	545	594	645	624	632
Louisiana	22	44	30	27	32	27	27	30	27	30	31
Maine	23	26	52	36	41	41	44	49	52	55	53
Maryland	24	231	211	189	205	235	221	211	197	258	240
Massachusetts	25	73	79	63	71	75	68	66	58	73	78
Michigan	26	2,688	2,289	2,663	2,862	2,450	2,750	2,548	2,450	3,306	3,224
Minnesota	27	6,472	6,720	6,678	6,409	5,928	6,490	4,599	6,820	7,276	7,310
Mississippi	28	22	35	39	31	25	29	25	34	0	0
Missouri	29	2,117	1,921	1,820	1,788	1,352	1,325	1,100	1,524	1,404	1,430
Montana	30	2,498	2,378	2,580	2,562	2,623	2,829	2,574	2,516	3,036	2,925
Nebraska	31	4,025	4,585	4,760	5,310	4,335	4,590	4,125	5,440	5,280	5,363
Nevada	32	534	598	578	569	621	598	603	603	759	731
New Hampshire	33	50	51	41	56	44	49	47	52	48	49
New Jersey	34	195	168	149	168	149	171	189	182	175	173
New Mexico	35	933	878	839	902	847	942	904	1,040	1,008	1,103
New York	36	2,964	2,796	2,208	2,504	2,498	2,511	2,673	2,327	2,614	2,860
North Carolina	37	23	34	29	34	31	34	41	37	58	59
North Dakota	38	2,285	2,659	2,760	2,133	2,480	3,648	2,392	1,920	3,990	3,700
Ohio	39	995	1,513	1,431	1,246	1,269	1,549	1,623	1,800	1,922	1,769

Table 31. Continued

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Oklahoma	40	1,351	1,573	1,488	1,914	1,564	1,166	1,120	1,320	1,215	1,518
Oregon	41	1,228	1,274	1,284	1,302	1,386	1,353	1,435	1,453	1,653	1,536
Pennsylvania	42	2,170	2,157	1,863	2,233	2,192	2,214	2,187	2,145	2,352	2,295
Rhode Island	44	7	7	8	7	7	7	8	7	8	8
South Carolina	45	0	0	0	0	0	0	0	0	0	0
South Dakota	46	3,859	3,807	4,836	3,669	3,389	3,900	1,840	4,025	6,000	5,500
Tennessee	47	142	178	180	197	208	212	228	245	252	263
Texas	48	646	700	924	1,012	946	940	1,080	846	880	893
Utah	49	1,395	1,373	1,297	1,449	1,518	1,472	1,610	1,628	1,669	1,805
Vermont	50	293	313	226	230	186	178	212	186	255	268
Virginia	51	228	231	216	203	224	226	154	148	248	274
Washington	53	1,647	1,769	1,792	1,580	1,889	1,750	1,800	1,761	1,911	1,811
West Virginia	54	193	202	223	212	216	196	168	180	212	149
Wisconsin	55	8,282	8,900	8,408	8,613	8,700	8,607	6,622	10,075	9,610	10,230
Wyoming	56	1,127	1,053	1,058	1,081	979	1,246	1,185	1,050	1,246	1,308
Total		74,562	77,169	78,041	79,144	74,672	77,979	69,828	80,402	87,294	88,314

Sources:

United States Department of Agriculture,1972
United States Department of Agriculture,1974
United States Department of Agriculture,1976
United States Department of Agriculture,1978
United States Department of Agriculture,1979
United States Department of Agriculture,1981

Table 32. Other hay production by state, 1970 - 1979

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Alabama	1	783	903	806	977	1,044	1,134	1,105	1,008	1,105	1,188
Arizona	4	88	86	103	94	92	84	95	96	66	69
Arkansas	5	1,182	1,056	973	1,383	1,040	1,278	1,088	1,207	1,419	1,591
California	6	1,323	964	971	963	910	1,034	954	1,060	1,014	995
Colorado	8	1,135	897	936	991	780	980	891	832	966	1,125
Connecticut	9	139	129	102	133	124	138	106	113	139	122
Delaware	10	54	34	32	32	30	26	29	26	22	21
Florida	12	286	343	311	367	414	404	427	452	619	619
Georgia	13	853	1,022	900	1,165	1,069	1,138	1,035	752	950	1,170
Idaho	16	437	421	448	522	542	630	580	607	658	495
Illinois	17	975	865	861	820	902	1,008	874	897	868	880
Indiana	18	896	907	732	952	950	998	950	998	914	871
Iowa	19	1,536	1,387	1,481	1,242	1,161	1,441	1,408	1,298	1,299	1,326
Kansas	20	1,514	2,010	1,980	1,984	1,500	1,950	1,785	2,112	1,820	2,340
Kentucky	21	2,435	2,368	2,208	2,498	2,405	2,345	2,394	2,448	2,538	2,502
Louisiana	22	562	635	605	713	725	711	688	688	704	818
Maine	23	382	369	326	335	330	310	384	288	410	332
Maryland	24	504	367	379	399	386	396	378	333	365	376
Massachusetts	25	166	162	142	181	166	195	188	175	198	207
Michigan	26	572	388	404	532	456	585	512	405	551	609
Minnesota	27	1,683	1,520	1,485	1,598	1,568	1,515	1,166	1,316	1,530	1,600
Mississippi	28	1,039	1,082	971	1,177	1,103	1,143	1,105	1,138	1,193	1,287
Missouri	29	3,418	3,488	3,713	4,160	4,139	4,305	3,848	4,176	4,640	4,785
Montana	30	1,614	1,494	1,782	1,538	1,638	1,419	1,404	1,391	1,540	1,404
Nebraska	31	1,974	2,348	2,380	2,166	1,935	1,913	1,828	2,090	2,258	2,255
Nevada	32	300	384	292	322	292	287	336	276	325	350
New Hampshire	33	154	133	122	116	124	130	133	133	133	139
New Jersey	34	136	128	117	136	122	134	109	124	152	174
New Mexico	35	111	142	93	99	68	99	80	84	84	96
New York	36	2,834	2,600	2,295	2,700	2,835	2,603	2,679	2,312	2,683	2,679
North Carolina	37	560	507	512	499	499	515	469	484	619	565
North Dakota	38	2,129	2,198	2,270	1,976	2,100	1,620	1,584	1,309	2,295	1,950

Table 32. Continued

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Ohio	39	1,918	1,700	1,703	2,140	1,882	2,019	1,931	1,758	1,953	1,849
Oklahoma	40	1,455	1,659	1,411	1,978	1,523	2,108	1,827	2,200	1,935	2,448
Oregon	41	1,141	1,020	995	964	1,105	1,054	1,024	984	1,120	1,032
Pennsylvania	42	2,226	2,194	1,889	2,147	2,100	2,052	1,908	1,744	1,971	1,998
Rhode Island	44	18	10	9	11	10	10	10	8	14	14
South Carolina	45	378	444	440	461	440	462	430	396	444	452
South Dakota	46	1,936	1,921	2,420	1,908	1,800	1,794	1,000	2,266	2,250	2,070
Tennessee	47	1,894	1,595	1,601	1,653	1,610	1,610	1,617	1,575	1,660	1,759
Texas	48	3,391	3,414	2,975	4,796	4,160	4,305	4,290	3,830	4,538	6,240
Utah	49	197	211	216	211	177	198	210	214	217	221
Vermont	50	611	681	625	677	658	552	648	535	638	578
Virginia	51	1,550	1,448	1,601	1,620	1,513	1,488	1,081	935	1,392	1,505
Washington	53	688	669	675	635	688	612	646	671	727	683
West Virginia	54	680	722	758	821	791	806	670	650	758	600
Wisconsin	55	2,319	2,183	1,795	2,009	1,900	1,995	1,504	1,927	2,025	2,325
Wyoming	56	726	742	728	805	665	698	770	589	804	819
Total		52,902	51,950	50,573	55,606	52,471	54,231	50,178	50,910	56,523	59,533

Sources: United States Department of Agriculture,1972
United States Department of Agriculture,1974
United States Department of Agriculture,1976
United States Department of Agriculture,1978
United States Department of Agriculture,1979
United States Department of Agriculture,1981

Table 33. Corn silage production by state, 1970 - 1979

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Alabama	1	276	330	550	462	384	520	656	399	510	529
Arizona	4	322	230	198	180	152	133	210	210	360	264
Arkansas	5	48	40	70	130	63	81	78	80	70	80
California	6	2,147	2,413	2,711	3,287	3,163	3,078	3,553	3,530	2,672	3,696
Colorado	8	4,182	3,643	5,510	5,550	4,503	4,012	4,560	4,356	4,826	4,800
Connecticut	9	744	825	517	729	700	842	816	910	954	769
Delaware	10	104	137	143	127	96	150	138	154	145	171
Florida	12	130	127	144	143	168	198	216	231	348	257
Georgia	13	494	936	900	1,170	1,161	1,000	1,300	720	1,200	1,092
Idaho	16	1,216	1,314	1,600	1,541	1,292	1,691	1,539	1,602	1,536	1,755
Illinois	17	3,444	3,900	3,953	3,727	3,910	4,208	3,848	3,263	3,875	3,680
Indiana	18	2,039	2,201	1,856	2,022	2,588	2,868	3,045	2,400	2,640	2,211
Iowa	19	7,579	9,063	9,600	9,765	10,580	11,475	12,125	10,938	10,560	10,500
Kansas	20	3,602	4,382	4,340	4,575	3,870	2,860	3,750	3,915	3,549	3,920
Kentucky	21	1,560	1,827	2,015	2,015	2,170	2,465	2,723	2,403	2,325	1,955
Louisiana	22	77	96	95	132	168	127	208	120	169	143
Maine	23	266	528	525	444	500	567	594	462	507	554
Maryland	24	1,125	1,140	1,400	1,302	1,246	1,500	1,575	1,573	1,515	1,504
Massachusetts	25	480	544	352	476	542	540	589	608	660	663
Michigan	26	3,816	4,980	4,134	4,620	4,294	5,125	4,830	5,250	5,250	4,995
Minnesota	27	7,166	9,143	8,201	8,050	9,157	9,951	10,281	10,790	9,375	10,125
Mississippi	28	494	365	540	430	506	456	750	660	875	900
Missouri	29	1,862	2,316	1,920	1,680	2,500	2,200	2,090	1,683	1,794	1,553
Montana	30	644	705	1,122	1,241	1,168	1,156	1,088	1,190	1,491	1,088
Nebraska	31	4,689	6,360	7,155	7,613	6,525	6,120	5,850	6,110	6,375	6,200
Nevada	32	45	31	51	50	51	47	50	45	0	0
New Hampshire	33	256	315	270	247	304	341	414	408	322	360
New Jersey	34	462	442	539	596	592	653	672	672	574	585
New Mexico	35	420	405	403	510	420	363	324	224	435	490
New York	36	7,602	7,686	6,290	7,625	8,151	8,910	7,860	8,502	9,207	8,437
North Carolina	37	1,553	1,553	1,694	1,800	1,750	1,755	1,750	1,500	1,834	1,885
North Dakota	38	1,809	1,932	1,974	1,556	1,854	1,588	1,465	1,693	1,836	1,688

Table 33. Continued

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Ohio	39	2,722	3,278	2,604	2,640	2,277	3,150	3,500	3,388	3,480	2,880
Oklahoma	40	666	588	660	465	312	392	275	391	438	656
Oregon	41	391	522	580	605	589	693	693	620	600	704
Pennsylvania	42	5,053	5,754	5,716	5,950	5,600	6,216	6,148	6,600	6,665	6,450
Rhode Island	44	65	62	44	52	56	62	62	62	66	56
South Carolina	45	243	334	444	585	456	750	728	504	605	594
South Dakota	46	5,256	7,378	6,014	6,678	6,345	5,760	3,780	5,400	5,166	4,056
Tennessee	47	1,254	1,458	2,349	2,295	2,309	1,958	2,400	1,950	2,175	1,914
Texas	48	1,232	1,360	1,764	1,632	975	1,085	1,600	1,980	1,875	1,733
Utah	49	1,062	980	1,173	1,295	1,326	1,440	1,280	1,054	1,136	1,482
Vermont	50	1,092	1,248	972	960	1,100	1,269	1,442	1,238	1,400	1,470
Virginia	51	2,225	3,192	2,562	2,640	2,408	2,970	2,821	2,556	3,375	2,700
Washington	53	858	1,020	1,148	1,160	936	1,160	1,292	1,280	1,219	1,100
West Virginia	54	464	570	513	543	500	540	570	581	405	525
Wisconsin	55	10,274	10,480	10,605	10,710	10,246	10,500	11,438	11,760	11,040	10,800
Wyoming	56	510	486	600	615	574	783	837	743	698	891
Total		94,020	108,619	108,520	112,620	110,537	115,708	117,813	116,708	118,132	114,860

Sources: United States Department of Agriculture,1972
United States Department of Agriculture,1974
United States Department of Agriculture,1976
United States Department of Agriculture,1978
United States Department of Agriculture,1979
United States Department of Agriculture,1981

Table 34. Sorghum silage production by state, 1970 - 1979

State Name	State Number	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		(thousand tons)									
Alabama	1	210	221	137	120	161	158	207	158	180	158
Arizona	4	162	135	126	70	84	96	83	102	85	68
Arkansas	5	286	219	231	313	120	147	124	179	126	162
California	6	270	228	272	187	153	198	187	123	153	171
Colorado	8	209	162	150	247	160	161	231	147	253	350
Georgia	13	190	455	187	196	198	286	360	126	363	390
Illinois	17	55	163	120	108	165	168	115	138	81	115
Indiana	18	84	338	180	156	115	84	100	72	91	58
Iowa	19	165	319	252	149	60	127	143	143	126	126
Kansas	20	2,112	3,707	4,160	3,600	2,544	2,340	2,494	3,750	2,200	3,840
Kentucky	21	52	156	108	96	113	108	163	138	72	58
Louisiana	22	55	60	44	88	77	120	110	99	90	90
Mississippi	28	585	480	488	550	360	364	230	338	455	473
Missouri	29	240	715	230	300	263	326	285	484	408	242
Nebraska	31	830	789	960	990	585	855	600	1,035	1,040	840
New Mexico	35	158	44	40	84	24	39	55	96	117	122
North Carolina	37	234	390	374	351	264	288	288	176	377	338
North Dakota	38	11	11	6	0	0	0	0	0	0	0
Oklahoma	40	252	450	500	700	429	330	328	374	405	490
South Carolina	45	104	136	184	116	126	90	108	72	105	99
South Dakota	46	215	384	406	269	254	271	135	448	464	344
Tennessee	47	55	252	195	168	147	99	132	80	116	72
Texas	48	605	963	594	618	460	672	600	800	525	280
Virginia	51	90	191	111	130	110	99	90	90	88	77
Total		7,229	10,968	10,055	9,606	6,972	7,426	7,168	9,168	7,920	8,963

Sources: United States Department of Agriculture,1972
United States Department of Agriculture,1974
United States Department of Agriculture,1976
United States Department of Agriculture,1978
United States Department of Agriculture,1979
United States Department of Agriculture,1981

Table 35. Consumption of roughages in the United States by livestock type, 1970 - 1979

Livestock Type and Roughage type	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Proportion of Total
	(million metric tons)										(Percent)
Dairy Animals:											
Hay	44.7	39.9	42.2	35.4	32.3	33.3	38.8	38.2	42.6	40.2	30.860
Other[a]	40.0	47.9	43.8	59.1	58.5	63.4	66.1	58.9	59.2	58.2	43.722
Cattle on Feed:											
Hay	16.5	10.0	6.2	2.4	14.1	24.8	17.0	12.2	26.5	25.7	12.373
Other	4.4	3.0	0.7	NAb	22.0	39.0	22.8	5.9	10.8	10.7	9.397
Other Beef Cattle:											
Hay	50.3	48.7	55.4	69.8	65.7	65.8	78.5	57.0	64.4	55.5	48.654
Other	30.1	44.4	44.9	56.0	58.4	60.1	65.1	71.3	72.7	65.6	44.786
Other Livestock:											
Hay	7.9	6.8	7.0	11.2	11.2	12.7	15.4	10.0	9.4	10.3	8.113
Other	3.4	3.6	3.2	0.3	0.3	0.3	0.3	5.4	4.7	5.1	2.095
Total:											
Hay	119.4	105.4	110.8	118.8	123.3	136.6	149.7	117.4	142.9	131.7	100.0
Other	77.9	98.9	92.6	115.4	139.2	162.8	154.3	141.5	147.4	139.6	100.0

[a]Other includes silage, beet pulp, and straw

Source: (Economic Research Service, 1985)

Note must add the following citation to references
Economic Research Service, 1985. Feed Outlook and Situation Yearbook,
United States Department of Agriculture, FdS-298, December

Table 36. Feedstuffs required for beef production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Alabama	1	136.11	0.00	38.44	13.44	5.11	6.89	123.67	963.00	1429.44	0.00
Arizona	4	137.44	146.67	38.89	13.56	5.22	6.89	227.56	578.22	1356.67	0.00
Arkansas	5	130.22	0.00	36.78	12.78	4.89	6.56	207.56	569.44	975.89	0.00
California	6	131.00	148.89	37.00	12.89	4.89	6.67	172.22	393.56	1167.33	0.00
Colorado	8	149.67	147.78	42.22	14.78	5.67	7.56	160.89	241.33	1394.22	0.00
Connecticut	9	136.56	0.00	38.56	13.44	5.11	6.89	151.00	329.78	1962.00	0.00
Delaware	10	131.89	0.00	37.22	13.00	5.00	6.67	525.33	539.22	1567.78	0.00
Florida	12	129.33	0.00	36.44	12.78	4.89	6.56	383.00	296.89	1281.78	0.00
Georgia	13	130.33	0.00	36.89	12.89	4.89	6.56	509.33	499.67	1348.78	0.00
Idaho	16	129.22	0.00	36.44	12.78	4.89	6.56	192.11	297.22	1199.78	0.00
Illinois	17	133.00	0.00	37.56	13.11	5.00	6.78	154.33	281.89	936.67	0.00
Indiana	18	195.44	0.00	34.44	24.56	12.33	10.00	580.33	105.22	978.33	0.00
Iowa	19	192.78	0.00	34.00	24.33	12.11	9.89	731.33	171.22	880.44	0.00
Kansas	20	192.33	0.00	33.89	24.22	12.11	9.78	529.78	127.22	706.33	0.00
Kentucky	21	221.00	50.11	13.89	25.33	19.01	0.11	266.00	361.89	536.11	0.00
Louisiana	22	221.22	50.11	13.89	25.44	19.01	0.11	254.22	193.67	475.89	33.78
Maine	23	226.11	51.22	14.22	26.00	19.35	0.44	297.44	110.78	474.00	16.00
Maryland	24	219.56	49.78	13.78	25.22	18.79	0.00	292.56	71.89	514.56	9.33
Massachusetts	25	216.44	49.00	13.56	24.89	18.68	1.00	185.56	413.56	221.89	36.89
Michigan	26	119.56	97.56	6.67	14.78	12.00	10.78	518.11	394.00	339.33	1.11
Minnesota	27	118.89	96.89	6.67	14.67	11.89	10.78	370.22	186.56	588.89	29.11
Mississippi	28	117.22	95.67	6.56	14.44	11.78	10.67	288.56	134.00	402.33	51.00
Missouri	29	115.67	94.33	6.44	14.22	11.56	10.56	195.89	114.44	247.11	193.11
Montana	30	87.44	17.00	8.11	6.11	3.44	7.78	76.56	526.78	949.78	43.33
Nebraska	31	155.56	162.22	8.22	6.22	3.56	8.00	245.22	904.00	612.11	0.00
Nevada	32	89.00	17.33	8.22	6.22	3.56	8.00	16.11	262.22	865.00	162.67
New Hampshire	33	86.22	16.67	8.00	6.11	3.44	7.67	109.11	427.44	366.56	19.44
New Jersey	34	87.44	17.00	8.11	6.11	3.44	7.78	43.89	361.89	441.44	35.78
New Mexico	35	111.00	15.89	13.78	8.78	3.67	9.78	0.00	406.67	444.44	112.11
New York	36	109.56	15.67	13.56	8.67	3.67	9.67	3.67	310.33	299.56	75.67
North Carolina	37	106.33	15.22	13.22	8.33	3.56	9.44	0.00	100.67	44.00	0.00
North Dakota	38	111.22	15.89	13.78	8.78	3.67	9.89	1.22	270.22	122.22	46.11

Table 36. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Ohio	39	79.00	13.56	6.22	5.33	1.89	8.89	8.22	271.11	118.00	118.44
Oklahoma	40	73.67	12.67	5.78	4.89	1.78	8.33	47.11	290.00	19.22	52.89
Oregon	41	79.44	13.56	6.22	5.33	1.89	8.89	10.00	224.33	40.33	23.67
Pennsylvania	42	85.00	90.78	4.11	10.78	10.56	8.00	137.00	150.22	45.89	41.78
Rhode Island	44	83.00	88.67	4.00	10.56	10.22	7.78	30.67	136.22	47.44	22.89
South Carolina	45	126.56	91.56	5.78	15.78	7.00	10.11	415.78	254.22	165.00	0.00
South Dakota	46	124.11	89.89	5.67	15.44	6.89	9.89	862.89	118.33	347.22	0.00
Tennessee	47	127.89	92.56	5.89	15.89	7.11	10.11	309.78	212.11	167.22	0.00
Texas	48	120.33	87.11	5.56	15.00	6.67	9.56	195.00	92.22	448.00	19.00
Utah	49	122.22	88.44	5.56	15.22	6.78	9.78	238.11	27.00	114.56	16.56
Vermont	50	117.00	84.78	5.44	14.56	6.44	9.33	304.67	21.11	45.67	26.67
Virginia	51	128.11	92.78	5.89	16.00	7.11	10.22	749.11	106.89	622.44	0.00
Washington	53	124.11	89.89	5.67	15.44	6.89	9.89	490.44	264.44	38.44	0.00
West Virginia	54	127.11	104.11	7.44	17.33	20.11	9.33	566.44	214.22	338.11	0.00
Wisconsin	55	129.44	106.11	7.56	17.67	20.56	9.44	408.44	316.33	176.89	0.00
Wyoming	56	126.11	103.22	7.33	17.22	20.00	9.22	456.67	64.33	186.44	13.89

to a few of these findings are then made based on the judgement of animal scientists at Iowa State University.

The final step in developing the rations per hundred pound liveweight is to weight the state values to the 31 livestock producing regions. The weights used to achieve this are shown in Table 37. The results of this operation are portrayed in Table 38. The weights are developed from the 1978 Agricultural Census and its county estimate on beef production. These weights, however, do not reflect the state differences that occur. Thus, before the state to market region weights are used, the rations are multiplied by the states projected levels of production provided by the National Interregional Agricultural Projection System for use in the 1980 Resource Conservation Act [7](Table 38).

The product of production times the ration times the state-to-livestock producing area weights and summed over the LPA provide the amount of feed required at the LPA level to meet the assumed projection levels. These feed requirements when divided by the projected production (projected State times the State to Livestock Producing area Weights) provides the market region ration for beef (Table 39) (Figure 9). The barley, corn, oats, and sorghum are converted into feedgrain units by the following expression:

$$FGMRFU = C + (s * 0.96) + (0 * 0.92) + (B * 0.94) + (0.5 * ((0.27 * CS) + (0.22 * SS)))$$

where:

C is corn fed;

S is sorghum fed;

Table 37. Weights used to allocate livestock production from state to market region

State Name	State FIPS Number	Livestock Producing Area	Beef	Sheep	Pork	Broiler	Turkey	Eggs	Milk
			(percent)						
Alabama	1	9	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Arizona	4	24	9.82	37.11	32.57	0.00	0.00	1.59	1.01
Arizona	4	28	90.18	62.89	67.43	100.00	100.00	98.41	98.99
Arkansas	5	13	39.86	54.67	45.36	18.37	28.95	23.02	43.08
Arkansas	5	14	27.35	4.75	9.45	36.25	0.00	39.47	10.70
Arkansas	5	18	32.79	40.58	45.19	45.38	71.05	37.51	46.22
California	6	30	29.56	42.91	27.49	4.52	7.74	8.87	14.91
California	6	31	70.44	57.09	72.51	95.48	92.26	91.13	85.09
Colorado	8	17	11.41	0.51	9.70	18.16	0.00	0.58	7.22
Colorado	8	18	2.44	0.00	1.07	0.00	0.00	0.14	0.28
Colorado	8	23	80.02	94.18	84.31	80.99	100.00	98.36	88.59
Colorado	8	24	6.13	5.31	4.92	0.85	0.00	0.92	3.91
Connecticut	9	1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Delaware	10	2	49.69	57.48	21.70	5.98	100.00	0.00	77.80
Delaware	10	3	50.31	42.52	78.30	94.02	0.00	100.00	22.20
Florida	12	4	0.53	0.00	2.74	9.98	0.00	5.85	3.60
Florida	12	5	89.85	91.81	67.68	65.63	42.37	93.99	89.87
Florida	12	9	9.62	8.19	29.58	24.39	57.63	0.16	6.53
Georgia	13	4	47.96	66.15	53.68	42.21	100.00	62.55	65.18
Georgia	13	5	10.25	4.31	15.80	1.08	0.00	1.81	4.17
Georgia	13	9	41.79	29.54	30.52	56.71	0.00	35.64	30.65
Idaho	16	25	2.30	0.40	6.01	10.04	11.38	11.13	1.87
Idaho	16	26	93.06	97.65	91.19	89.96	88.62	87.75	88.01
Idaho	16	27	4.64	1.95	2.80	0.00	0.00	1.12	10.12
Illinois	17	8	14.09	9.29	14.50	9.54	96.94	11.10	7.43
Illinois	17	11	2.81	2.16	1.75	1.94	2.15	5.71	12.10
Illinois	17	12	70.02	79.68	70.70	79.59	0.78	56.15	58.29
Illinois	17	13	13.08	8.87	13.05	8.93	0.13	27.04	22.18
Indiana	18	6	7.07	4.35	5.66	0.00	0.00	1.14	6.35
Indiana	18	7	8.30	21.56	11.49	23.72	5.94	24.37	34.43
Indiana	18	8	79.47	70.67	78.27	76.24	94.06	71.28	54.22
Indiana	18	11	2.21	2.26	1.74	0.04	0.00	1.22	4.72
Indiana	18	12	2.95	1.16	2.84	0.00	0.00	1.99	0.28
Iowa	19	12	59.83	73.31	74.24	85.48	91.13	81.38	82.04
Iowa	19	15	34.98	24.22	21.77	11.65	8.87	12.17	10.93
Iowa	19	16	5.19	2.47	3.99	2.87	0.00	6.45	7.03
Kansas	20	15	15.83	17.22	31.90	27.57	0.00	21.05	36.19
Kansas	20	17	23.56	33.68	26.61	11.04	0.00	4.43	16.71
Kansas	20	18	60.61	49.10	41.49	61.39	100.00	74.52	47.10
Kentucky	21	6	3.19	2.48	1.10	0.05	0.00	49.64	3.14
Kentucky	21	8	94.01	96.17	90.71	99.95	100.00	49.31	94.34
Kentucky	21	9	0.87	0.00	1.85	0.00	0.00	0.85	0.76
Kentucky	21	13	1.93	1.35	6.34	0.00	0.00	0.20	1.76

Table 37. Continued

State Name	State FIPS Number	Livestock Producing Area	Beef	Sheep	Pork	Broiler	Turkey	Eggs	Milk
			(Percent)						
Louisiana	22	14	94.62	100.00	98.35	74.94	79.69	94.40	89.23
Louisiana	22	19	5.38	0.00	1.65	25.06	20.31	5.60	10.77
Maine	23	1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Maryland	24	2	3.94	1.15	1.08	0.00	0.00	4.90	600.00
Maryland	24	3	96.06	98.85	98.92	100.00	100.00	95.10	95.23
Massachusetts	25	1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Michigan	26	7	95.60	98.60	99.68	99.94	100.00	99.48	95.03
Michigan	26	10	2.16	1.24	0.12	0.04	0.00	0.18	1.84
Michigan	26	11	2.24	0.16	0.20	0.02	0.00	0.34	3.13
Minnesota	27	10	71.96	75.56	71.21	99.46	93.51	80.60	73.25
Minnesota	27	11	18.05	12.22	14.91	0.23	6.49	9.22	22.17
Minnesota	27	12	2.55	2.70	7.17	0.10	0.00	6.22	2.18
Minnesota	27	16	7.44	9.52	6.71	0.21	0.00	3.96	2.40
Mississippi	28	9	13.49	17.09	20.10	4.55	48.35	3.39	16.44
Mississippi	28	13	1.48	0.00	2.45	0.00	0.00	1.97	2.28
Mississippi	28	14	85.03	82.91	77.45	95.45	51.65	94.64	81.28
Missouri	29	12	9.71	33.24	18.51	0.08	0.00	1.12	4.75
Missouri	29	13	19.99	5.11	20.57	27.29	4.48	22.56	23.88
Missouri	29	15	63.87	59.86	57.37	10.96	85.50	25.29	61.38
Missouri	29	18	6.43	1.79	3.55	61.67	10.02	51.03	9.99
Montana	30	16	2.10	13.93	1.09	0.00	14.64	0.47	0.67
Montana	30	22	59.06	59.48	56.82	22.36	65.74	23.46	29.52
Montana	30	25	38.84	26.59	42.09	77.64	19.62	76.07	69.81
Nebraska	31	15	31.60	30.28	56.24	54.18	36.91	85.71	50.16
Nebraska	31	16	4.60	3.49	10.04	6.12	56.86	3.01	10.72
Nebraska	31	17	58.04	33.15	32.01	37.29	5.24	10.80	37.73
Nebraska	31	23	5.76	33.08	1.71	2.41	1.00	0.48	1.39
Nevada	32	27	70.33	76.41	28.33	15.66	0.00	48.63	7.18
Nevada	32	28	3.89	0.55	0.86	0.00	0.00	19.49	33.31
Nevada	32	30	25.78	23.04	70.81	84.34	100.00	31.88	59.51
New Hampshire	33	1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
New Jersey	34	2	100.00	100.00	100.00	100.00	100.00	100.00	100.00
New Mexico	35	21	63.10	56.17	79.45	60.97	6.46	60.97	42.69
New Mexico	35	24	28.42	43.81	19.87	35.88	93.54	35.88	56.48
New Mexico	35	28	8.48	0.02	0.68	3.15	0.00	3.15	0.83
New York	36	1	2.24	0.38	0.94	0.00	0.00	0.04	2.92
New York	36	2	86.47	93.11	85.21	99.01	23.92	91.73	87.09
New York	36	6	11.29	6.51	13.85	0.99	76.08	8.23	9.99
North Carolina	37	3	36.02	27.70	83.71	44.45	52.51	43.32	27.88
North Carolina	37	4	56.92	23.74	16.21	52.43	47.49	56.46	66.61
North Carolina	37	6	7.06	48.56	0.08	3.12	0.00	0.22	5.51
North Dakota	38	10	28.76	32.01	53.47	42.91	93.30	49.69	27.88
North Dakota	38	16	71.24	67.99	46.53	57.09	6.70	50.31	72.12
Ohio	39	6	83.93	79.46	66.96	91.04	47.40	52.98	83.38
Ohio	39	7	16.07	20.54	33.04	8.96	52.60	47.02	16.62

Table 37. Continued

State Name	State FIPS Number	Livestock Producing Area	Beef	Sheep	Pork	Broiler	Turkey	Eggs	Milk
			(percent)						
Oklahoma	40	14	9.44	0.23	6.75	35.83	0.00	24.34	5.82
Oklahoma	40	18	81.53	97.94	86.49	64.17	100.00	75.33	92.21
Oklahoma	40	21	9.03	1.83	6.76	0.00	0.00	0.33	1.97
Oregon	41	26	28.98	7.34	9.39	0.00	0.00	0.51	11.04
Oregon	41	29	63.64	87.56	89.96	100.00	100.00	99.49	85.86
Oregon	41	30	7.38	5.10	0.65	0.00	0.00	0.00	3.10
Pennsylvania	42	2	65.06	51.23	84.24	98.39	96.64	91.12	69.95
Pennsylvania	42	3	3.30	2.14	4.88	1.50	0.04	2.52	6.34
Pennsylvania	42	6	31.64	46.63	10.88	0.11	3.32	6.36	23.71
Rhode Island	44	1	100.00	100.00	100.00	100.00	100.00	100.00	100.00
South Carolina	45	4	100.00	100.00	100.00	100.00	100.00	100.00	100.00
South Dakota	46	10	2.32	1.30	2.59	4.60	0.01	2.54	7.31
South Dakota	46	16	97.68	98.70	97.41	95.40	99.99	97.46	92.69
Tennessee	47	4	28.72	17.41	10.84	84.92	43.39	27.22	43.78
Tennessee	47	8	31.58	47.39	29.34	7.53	10.58	29.72	24.40
Tennessee	47	9	25.67	32.61	31.80	7.55	34.39	5.33	25.49
Tennessee	47	13	14.03	2.59	28.02	0.00	11.64	37.73	6.33
Texas	48	14	4.60	0.03	1.90	12.99	0.00	16.76	20.66
Texas	48	18	8.23	0.28	4.01	0.00	0.00	0.32	4.98
Texas	48	19	33.30	4.98	36.82	63.46	48.13	32.43	49.69
Texas	48	20	28.82	77.53	39.36	23.55	51.87	49.04	18.44
Texas	48	21	24.71	17.15	17.65	0.00	0.00	1.43	4.95
Texas	48	24	0.34	0.03	0.26	0.00	0.00	0.02	1.28
Utah	49	23	17.53	14.74	13.29	0.00	0.00	0.56	5.48
Utah	49	24	8.95	3.26	7.03	0.00	0.00	0.10	1.08
Utah	49	27	70.70	81.56	79.11	100.00	100.00	99.34	92.47
Utah	49	28	2.82	0.44	0.57	0.00	0.00	0.00	0.97
Vermont	50	1	95.89	94.31	98.92	100.00	100.00	99.37	98.25
Vermont	50	2	4.11	5.69	1.08	0.00	0.00	0.63	1.75
Virginia	51	3	73.98	70.44	94.94	100.00	100.00	95.53	76.28
Virginia	51	4	12.45	13.23	1.82	0.00	0.00	3.12	10.64
Virginia	51	6	13.57	16.33	3.24	0.00	0.00	1.35	13.08
Washington	53	25	3.59	2.26	10.03	0.00	18.26	11.42	2.40
Washington	53	26	6.42	8.92	17.55	0.00	0.00	0.15	0.28
Washington	53	29	89.99	88.82	72.42	100.00	81.74	88.43	97.32
West Virginia	54	3	25.35	42.88	57.81	100.00	100.00	51.67	32.15
West Virginia	54	6	74.65	57.12	42.19	0.00	0.00	48.33	67.85

Table 37. Continued

State Name	State FIPS Number	Livestock Producing Area	Beef	Sheep	Pork	Broiler	Turkey	Eggs	Milk
			(percent)						
Wisconsin	55	10	6.36	8.28	2.07	0.06	42.77	2.04	5.18
Wisconsin	55	11	61.21	62.31	55.78	99.54	57.23	65.12	74.11
Wisconsin	55	12	32.43	29.41	42.15	0.40	0.00	32.84	20.71
Wyoming	56	16	12.20	6.71	7.39	0.00	0.00	10.07	6.31
Wyoming	56	22	35.57	50.01	38.38	28.30	83.56	49.65	33.97
Wyoming	56	23	51.25	43.28	54.23	71.70	16.44	39.74	56.66
Wyoming	56	26	0.98	0.00	0.00	0.00	0.00	0.54	3.06

Source: 1978 Agricultural Census -- inventory is used for calculation of the beef and dairy weights, sales is used for the other livestock commodities

Table 38. State livestock production projections for the year 2000

State Name	State Number	Beef	Sheep	Pork	Chicken	Broiler	Turkey	Eggs	Milk
		.....(thousand pounds liveweight).....						(1000)	(Mil. lbs)
Alabama	1	893446.10	71.90	421635.20	142434.30	2917036.00	278.80	3665.70	828.70
Arizona	4	1023070.70	23796.70	94209.50	2275.20	0.00	34.90	115.80	1404.50
Arkansas	5	1258751.00	203.60	141450.00	374111.10	3675240.00	387080.10	5535.80	748.00
California	6	2497149.00	48366.00	40453.10	117561.30	700723.10	366691.10	10371.60	16893.80
Colorado	8	2617132.00	76223.60	259551.30	22531.50	0.00	156735.10	646.80	1053.30
Connecticut	9	24103.70	197.70	2715.00	28672.40	206.00	557.70	982.60	635.00
Delaware	10	8570.20	89.80	43168.10	5389.90	972894.70	34.90	125.50	130.50
Florida	12	1076634.00	173.70	99639.50	105765.40	875028.20	34.90	3753.90	2810.20
Georgia	13	735432.30	95.80	760192.40	198873.40	1927246.00	43984.80	8903.60	1790.50
Idaho	16	843095.70	37590.70	13574.90	5787.50	618.10	34.90	153.80	1820.10
Illinois	17	1118414.00	3180.50	3337516.00	34283.20	3296.60	9410.40	1393.60	2521.00
Indiana	18	740788.60	3533.90	2003649.00	72520.40	43679.30	126203.60	3145.80	2256.00
Iowa	19	3470406.00	7481.00	6413303.00	36646.80	50890.50	129375.30	1609.40	2198.20
Kansas	20	3701800.00	3318.20	1112324.00	25160.10	4326.70	2614.00	193.80	1327.80
Kentucky	21	1314993.00	1647.10	546252.40	22376.80	27196.50	348.50	432.40	2748.40
Louisiana	22	533496.50	173.70	82263.60	28252.70	440707.60	34.90	825.40	1419.20
Maine	23	27317.60	431.30	2172.00	74884.00	529714.50	69.70	2116.90	653.80
Maryland	24	114091.10	724.70	80906.20	12679.50	1323153.00	766.80	364.80	1822.80
Massachusetts	25	29995.80	305.50	21448.30	14998.90	824.10	244.00	457.90	469.50
Michigan	26	536710.20	6564.60	333398.30	43163.30	5356.90	28022.00	1379.10	4972.10
Minnesota	27	1732792.00	8181.80	1614051.00	49149.60	86534.40	554794.30	1955.60	10632.90
Mississippi	28	953437.40	161.70	193849.00	123812.70	1757679.00	34.90	1644.60	748.00
Missouri	29	2491257.00	6139.30	1938489.00	76960.40	161737.00	254707.40	1154.30	3246.10
Montana	30	1381413.00	22269.30	112128.30	7863.90	0.00	0.00	199.30	200.40
Nebraska	31	3753222.00	4528.10	1798668.00	10293.80	13804.30	801.60	577.20	1310.30
Nevada	32	265676.80	8828.70	3801.00	44.20	0.00	0.00	2.10	212.60
New Hampshire	33	16069.20	359.40	4615.50	11089.00	618.10	348.50	277.20	380.70
New Jersey	34	29460.10	293.50	29321.70	8416.20	3090.50	1986.60	403.40	153.40
New Mexico	35	843095.70	13584.40	73032.70	7488.40	0.00	941.00	355.10	474.90
New York	36	394765.90	2641.40	41267.60	70863.70	4326.70	2927.70	2183.80	11613.60
North Carolina	37	315491.40	257.60	1105808.00	202915.90	2111441.00	651616.10	3016.80	2019.20

Table 38. (Continued)

State Name	State Number	Beef	Sheep	Pork	Chicken	Broiler	Turkey	Eggs	Milk
		.....(thousand pounds liveweight).....						(1000)	(Mil. lbs)
North Dakota	38	1128056.00	11380.20	138463.50	4020.30	0.00	10037.70	94.50	877.10
Ohio	39	776141.10	26258.40	685259.00	51314.30	90243.10	36177.70	1874.90	4629.00
Oklahoma	40	3485404.00	3216.40	173758.20	17539.20	274231.70	35410.90	446.80	1076.20
Oregon	41	469219.70	17304.00	42353.60	11022.80	99720.60	6866.10	525.40	1150.20
Pennsylvania	42	475647.40	4624.00	251406.40	108239.40	562886.00	114667.20	3469.90	8459.00
Rhode Island	44	1606.90	59.90	2986.50	1745.10	618.10	174.30	56.50	59.20
South Carolina	45	266748.20	41.90	382267.90	38436.00	173068.90	179424.60	1742.50	597.30
South Dakota	46	2257719.00	63172.30	927434.60	17075.30	0.00	30182.90	129.60	1926.40
Tennessee	47	1089489.00	347.40	406702.80	26750.60	279588.60	69.70	1132.30	2021.90
Texas	48	8475951.00	119863.90	560641.60	77424.30	1162240.00	303606.60	2136.20	4524.10
Utah	49	318169.60	33404.00	20362.30	5942.10	206.00	103514.20	286.90	1360.10
Vermont	50	72846.90	395.30	2172.00	2694.90	0.00	34.90	103.40	2552.00
Virginia	51	513677.90	11679.70	228057.70	35122.60	718442.20	177960.70	705.40	1976.20
Washington	53	502429.40	521.10	35837.60	29865.30	101574.90	1045.60	1070.90	3392.70
West Virginia	54	140873.10	7073.70	27421.20	7886.00	67991.30	34469.90	121.40	314.80
Wisconsin	55	1138232.00	4899.50	494396.60	35652.80	79529.20	85948.10	953.70	22837.10
Wyoming	56	672762.20	35913.70	13303.40	176.70	0.00	0.00	22.80	67.30
Total		56527051.40	621570.60	27117678.50	2408173.20	21247709.40	3840305.60	72816.70	137316.10

Source: Unpublished data provided by the Economic Research Service's National Interregional Agricultural Projection System in 1978.

Table 39. Beef rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	261.612	0.148	0.149	0.269
2	177.484	0.133	0.103	0.180
3	266.706	0.154	0.138	0.356
4	247.654	0.134	0.088	0.377
5	313.809	0.098	0.073	0.551
6	171.432	0.137	0.094	0.221
7	235.740	0.156	0.153	0.396
8	321.094	0.166	0.219	0.378
9	311.740	0.115	0.090	0.600
10	255.569	0.158	0.158	0.318
11	262.452	0.147	0.260	0.344
12	303.426	0.138	0.171	0.461
13	263.682	0.129	0.120	0.353
14	255.166	0.149	0.151	0.282
15	309.316	0.144	0.146	0.428
16	238.201	0.147	0.101	0.400
17	361.274	0.126	0.090	0.535
18	205.769	0.134	0.096	0.278
19	257.966	0.144	0.102	0.214
20	257.167	0.143	0.100	0.213
21	228.897	0.142	0.084	0.219
22	230.040	0.122	0.108	0.406
23	435.644	0.118	0.110	0.430
24	329.930	0.129	0.073	0.377
25	227.187	0.117	0.054	0.446
26	270.845	0.105	0.070	0.392
27	230.392	0.131	0.079	0.240
28	436.013	0.107	0.077	0.577
29	167.375	0.142	0.074	0.234
30	399.926	0.103	0.070	0.443
31	429.911	0.100	0.073	0.470
Average	282.397	0.135	0.116	0.368

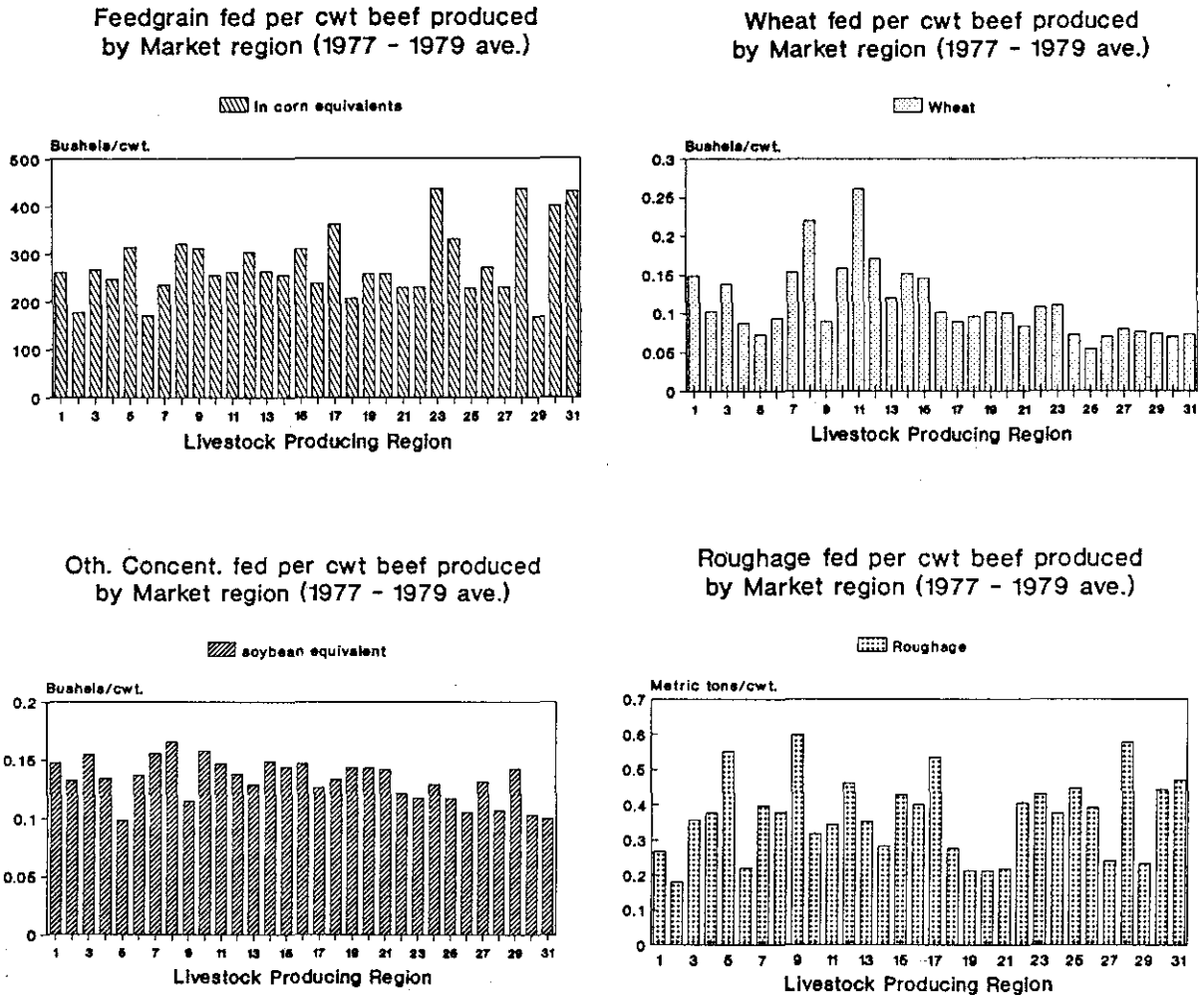

Figure 9. Rations required in the production of beef by livestock production area

O is oats fed;

B is burley fed;

CS is corn silage fed;

SS is sorghum silage fed.

While a portion of both corn and sorghum silage are included in feed grain concentrates, the majority of this type of feed is in the roughage feed category.

Hogs

Hog feed concentrate consumption is determined in a manner similar to beef. USDA feed concentrate data for the period 1968-1975 are multiplied times production data taken from various Agricultural Statistics publications. Next, the average state feed concentrate rations are determined by dividing the feed by production (Table 40) so that average state feed concentrate rations could be developed (Table 40).

As with beef, production information provided by the 1978 Agricultural Census is used to develop state-to-livestock production-area weights (See Table 37). In addition, the NIRAP state projections made for the 1980 RCA on pork production is used to provide measures of importance to the state ration information (See Table 38). When combined and appropriately weighted, market region rations are developed (Table 41) (Figure 10). The feed grain category is determined by developing a feed unit in a manner similar to beef. However, no silages are included and the crop conversion ratios for barley, oats, and sorghum are slightly different. The following is used:

Table 40. Feedstuffs required for pork production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Alabama	1	318.11	0.00	7.67	5.00	3.56	34.00	0.00	0.00	0.00	0.00
Arizona	4	301.89	0.00	7.22	4.89	3.44	50.44	0.00	0.00	0.00	0.00
Arkansas	5	339.89	0.00	8.22	5.44	3.89	36.33	0.00	0.00	0.00	0.00
California	6	298.78	0.00	7.22	4.78	3.44	47.56	0.00	0.00	0.00	0.00
Colorado	8	311.11	0.00	6.78	4.44	3.11	44.44	0.00	0.00	0.00	0.00
Connecticut	9	320.00	0.00	7.67	5.11	3.56	34.22	0.00	0.00	0.00	0.00
Delaware	10	392.89	0.00	7.00	4.67	3.33	31.11	0.00	0.00	0.00	0.00
Florida	12	285.33	0.00	6.89	4.56	3.22	30.44	0.00	0.00	0.00	0.00
Georgia	13	333.33	0.00	6.78	4.44	3.22	40.44	0.00	0.00	0.00	0.00
Idaho	16	294.44	0.00	6.22	4.22	3.00	27.89	0.00	0.00	0.00	0.00
Illinois	17	403.33	0.00	6.89	4.56	3.22	43.33	0.00	0.00	0.00	0.00
Indiana	18	405.56	0.00	6.44	4.56	3.33	43.33	0.00	0.00	0.00	0.00
Iowa	19	382.22	0.00	6.89	4.89	3.44	32.22	0.00	0.00	0.00	0.00
Kansas	20	333.33	0.00	6.56	4.67	3.33	55.44	0.00	0.00	0.00	0.00
Kentucky	21	322.11	8.56	7.00	5.11	3.89	33.78	0.00	0.00	0.00	0.00
Louisiana	22	315.67	8.33	6.89	5.00	3.78	33.00	0.00	0.00	0.00	0.00
Maine	23	319.33	8.44	7.00	5.00	3.89	33.33	0.00	0.00	0.00	0.00
Maryland	24	318.11	8.44	6.89	5.00	3.78	33.22	0.00	0.00	0.00	0.00
Massachusetts	25	311.11	8.22	6.89	4.89	3.78	32.44	0.00	0.00	0.00	0.00
Michigan	26	298.44	33.33	8.22	7.00	4.78	42.56	0.00	0.00	0.00	0.00
Minnesota	27	333.33	32.33	8.00	6.89	4.67	41.11	0.00	0.00	0.00	0.00
Mississippi	28	282.67	31.67	7.78	6.67	4.56	40.33	0.00	0.00	0.00	0.00
Missouri	29	333.33	30.33	7.56	6.33	4.33	38.67	0.00	0.00	0.00	0.00
Montana	30	282.56	12.44	4.56	4.22	3.56	32.22	0.00	0.00	0.00	0.00
Nebraska	31	333.33	12.78	4.67	4.22	3.67	55.67	0.00	0.00	0.00	0.00
Nevada	32	267.67	11.78	4.22	3.89	3.44	30.44	0.00	0.00	0.00	0.00
New Hampshire	33	282.78	12.44	4.56	4.22	3.56	32.22	0.00	0.00	0.00	0.00
New Jersey	34	294.44	12.89	4.78	4.22	3.78	33.56	0.00	0.00	0.00	0.00
New Mexico	35	274.56	11.33	5.56	4.11	4.11	50.22	0.00	0.00	0.00	0.00
New York	36	277.44	11.44	5.56	4.11	4.11	31.78	0.00	0.00	0.00	0.00
North Carolina	37	333.33	12.11	6.00	4.33	4.33	33.78	0.00	0.00	0.00	0.00
North Dakota	38	388.89	11.44	5.56	4.22	4.11	44.89	0.00	0.00	0.00	0.00
Ohio	39	333.33	12.11	4.33	4.00	3.56	33.22	0.00	0.00	0.00	0.00
Oklahoma	40	275.00	12.67	4.56	4.11	3.56	44.44	0.00	0.00	0.00	0.00

Table 40. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Oregon	41	333.33	12.78	4.56	4.11	3.67	34.78	0.00	0.00	0.00	0.00
Pennsylvania	42	333.33	34.89	8.78	5.78	4.22	42.78	0.00	0.00	0.00	0.00
Rhode Island	44	238.78	33.00	8.22	5.56	4.00	40.33	0.00	0.00	0.00	0.00
South Carolina	45	274.22	20.89	9.11	5.56	14.33	36.44	0.00	0.00	0.00	0.00
South Dakota	46	333.33	22.67	9.89	6.11	15.56	39.67	0.00	0.00	0.00	0.00
Tennessee	47	277.11	21.11	9.22	5.67	14.56	36.89	0.00	0.00	0.00	0.00
Texas	48	267.67	20.33	8.89	5.56	14.00	35.67	0.00	0.00	0.00	0.00
Utah	49	270.22	20.56	8.89	5.56	14.11	36.00	0.00	0.00	0.00	0.00
Vermont	50	249.44	19.00	8.22	5.11	13.00	33.22	0.00	0.00	0.00	0.00
Virginia	51	297.11	22.56	9.89	6.11	15.56	39.67	0.00	0.00	0.00	0.00
Washington	53	285.56	21.78	9.44	5.89	14.89	38.00	0.00	0.00	0.00	0.00
West Virginia	54	333.33	16.00	6.56	5.22	3.67	33.33	0.00	0.00	0.00	0.00
Wisconsin	55	333.33	16.00	6.56	5.22	3.67	33.33	0.00	0.00	0.00	0.00
Wyoming	56	280.56	16.22	6.67	5.33	3.78	33.78	0.00	0.00	0.00	0.00

Table 41. Pork rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	287.17	0.50	0.06	0.00
2	325.83	0.60	0.06	0.00
3	315.37	0.52	0.09	0.00
4	296.67	0.56	0.12	0.00
5	293.62	0.55	0.05	0.00
6	327.24	0.53	0.06	0.00
7	329.66	0.60	0.06	0.00
8	356.85	0.62	0.06	0.00
9	296.09	0.54	0.08	0.00
10	339.68	0.62	0.07	0.00
11	336.39	0.57	0.06	0.00
12	357.45	0.54	0.05	0.00
13	342.40	0.60	0.07	0.00
14	293.57	0.57	0.07	0.00
15	334.99	0.63	0.06	0.00
16	335.37	0.61	0.16	0.00
17	313.96	0.83	0.05	0.00
18	302.24	0.74	0.06	0.00
19	269.28	0.53	0.21	0.00
20	269.07	0.54	0.21	0.00
21	267.07	0.62	0.15	0.00
22	271.78	0.49	0.05	0.00
23	291.90	0.68	0.05	0.00
24	278.42	0.73	0.06	0.00
25	272.61	0.49	0.07	0.00
26	284.95	0.48	0.10	0.00
27	270.70	0.53	0.20	0.00
28	281.35	0.76	0.05	0.00
29	305.09	0.54	0.12	0.00
30	275.25	0.66	0.05	0.00
31	278.59	0.71	0.05	0.00
Average	335.13	0.59	0.07	0.00

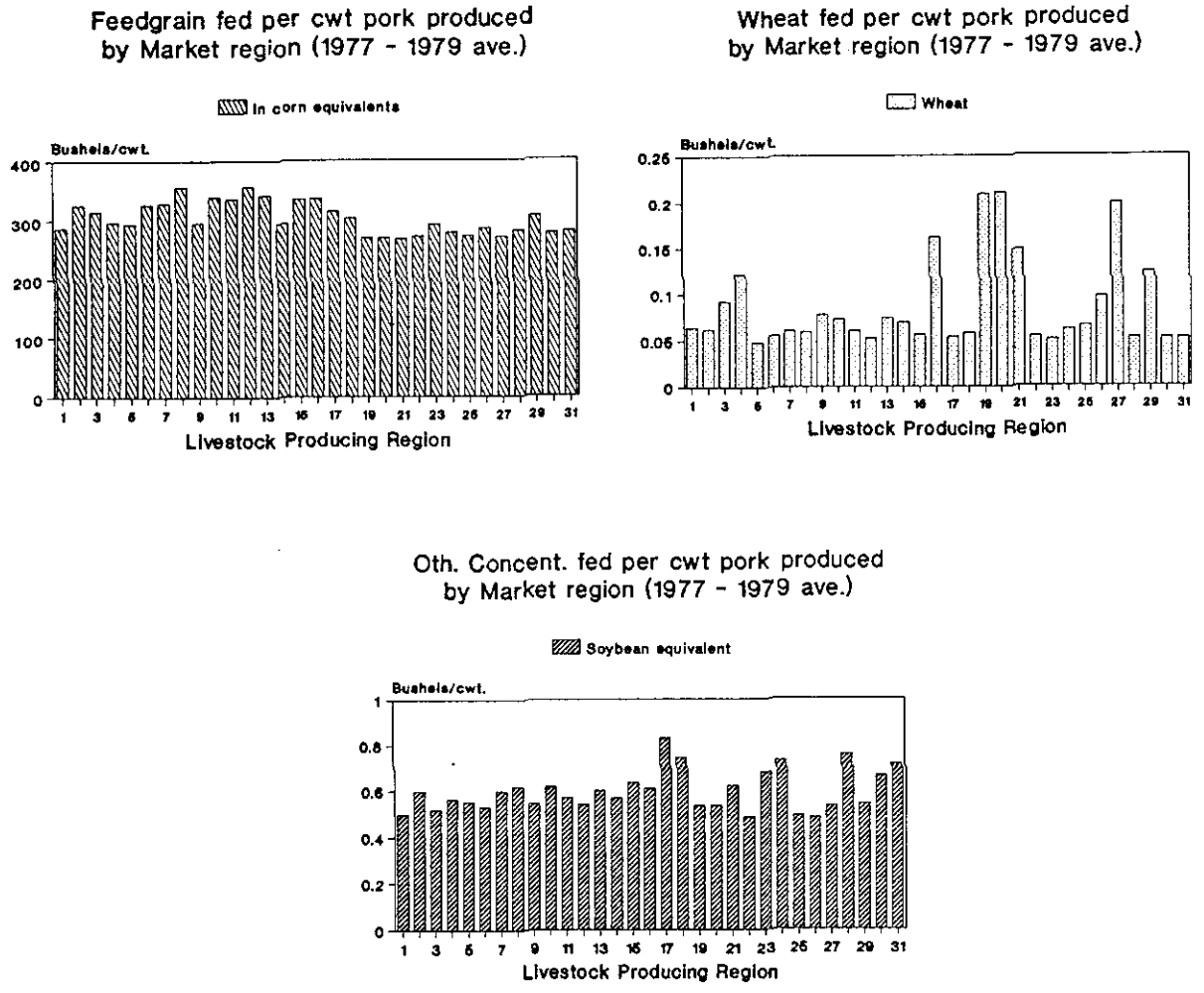

Figure 10. Rations required in the production of pork by livestock producing area

FGMRFU = C + ((S + O + B) * 0.90))

where: FGMRFU, C, S, O, and B have been previously defined.

Dairy

Feed consumption in the production of milk is derived in a similar fashion to beef and hogs. However since milk production is not characterized by production cycles, the three most recent years of concentrate feed consumption available (1975-1977) are used to derive the average feed consumption in the production of milk.

USDA region concentrate feed consumption for milk cows is weighted to states by milk production for the 1975-1977 time period (United States Department of Agriculture, 1980). Total state feed concentrate is then divided by average production to determine state level rations (Table 42). As with beef and pork, these rations are multiplied by projected production levels (expressed in Table 37 and weighted to market region using information from the 1978 Agricultural Census. The results are the market region ration shown in Table 43 and Figure 11. The feedgrain barley, corn, oats, sorghum and the silages, are converted to feedgrain units using the following:

FGMRFU = B + C + S + (O * 0.90) + (0.5 ((0.20 * CS) + (0.18 *SS)))

where: B, C, S, O, CS, and SS has been previously defined. As with beef, I leave the development of the silage coefficients to the roughage system.

Eggs

The next major value of feed concentrates is the production of eggs. As in the case of milk, the 1975-1977 data are used to determine

Table 42. Feedstuffs required for milk production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per 100 pounds)									
Alabama	1	26.56	0.00	6.22	2.11	0.67	2.67	14.33	38.67	104.00	0.00
Arizona	4	27.11	0.00	6.33	2.11	0.67	2.67	13.89	36.44	87.78	0.00
Arkansas	5	26.44	0.00	6.22	2.11	0.67	2.67	11.89	33.78	114.11	0.00
California	6	27.11	0.00	6.33	2.11	0.67	2.67	13.67	16.11	105.22	0.00
Colorado	8	27.89	0.00	6.56	2.22	0.67	2.78	8.56	20.44	139.89	0.00
Connecticut	9	27.22	0.00	6.33	2.11	0.67	2.67	26.44	26.00	86.33	0.00
Delaware	10	27.00	0.00	6.33	2.11	0.67	2.67	32.11	22.89	105.22	0.00
Florida	12	28.89	0.00	6.67	2.22	0.67	2.89	24.67	20.78	69.33	0.22
Georgia	13	26.22	0.00	6.11	2.00	0.67	2.56	13.67	15.11	85.33	0.00
Idaho	16	26.22	0.00	6.11	2.00	0.56	2.56	10.78	18.33	72.00	0.00
Illinois	17	26.56	0.00	6.22	2.11	0.67	2.67	41.78	7.44	73.44	0.00
Indiana	18	27.22	0.00	5.78	2.22	0.67	2.56	47.67	10.00	53.44	0.00
Iowa	19	26.22	0.00	5.67	2.11	0.67	2.56	41.89	9.11	59.22	0.00
Kansas	20	27.11	0.00	5.78	2.22	0.67	2.56	17.33	18.67	29.33	0.00
Kentucky	21	27.33	0.67	5.33	2.44	0.78	2.56	15.67	11.22	28.67	1.00
Louisiana	22	28.33	0.67	5.56	2.56	0.78	2.56	23.11	7.22	28.44	0.89
Maine	23	28.67	0.67	5.67	2.56	0.78	2.56	23.44	4.67	39.44	0.44
Maryland	24	29.11	0.78	5.67	2.56	0.78	2.56	6.33	19.00	6.78	1.56
Massachusetts	25	27.89	0.67	5.44	2.44	0.78	2.56	50.56	28.33	29.11	0.00
Michigan	26	26.11	2.22	6.56	3.00	0.89	3.11	32.00	15.11	30.11	2.44
Minnesota	27	24.89	2.11	6.22	2.89	0.78	2.89	24.78	10.22	29.22	4.11
Mississippi	28	26.22	2.22	6.56	3.00	0.89	3.11	13.89	8.78	15.78	14.56
Missouri	29	26.22	2.22	6.56	3.00	0.89	3.11	2.33	13.33	28.89	1.00
Montana	30	26.56	1.11	5.00	2.00	0.67	2.56	9.11	34.33	25.00	0.00
Nebraska	31	27.22	1.22	5.11	2.11	0.67	2.67	0.78	9.44	30.22	4.89
Nevada	32	26.33	1.11	5.00	2.00	0.67	2.56	4.89	19.33	16.89	0.78
New Hampshire	33	27.22	1.22	5.11	2.11	0.67	2.56	1.67	10.89	12.56	0.56
New Jersey	34	27.22	1.22	5.11	2.11	0.67	2.67	0.00	15.00	20.56	3.11
New Mexico	35	35.00	0.78	7.00	2.56	0.89	3.44	0.11	8.67	9.33	2.78
New York	36	34.56	0.78	7.00	2.56	0.89	3.44	0.00	2.89	1.44	0.00
North Carolina	37	33.44	0.78	6.67	2.56	0.78	3.33	0.00	16.67	7.33	2.56
North Dakota	38	37.56	0.78	7.56	2.78	0.89	3.67	0.33	14.22	9.78	5.11
Ohio	39	33.22	1.56	6.22	2.56	0.89	3.56	2.00	14.00	0.56	1.67

Table 42. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per 100 pounds)									
Oklahoma	40	31.22	1.44	5.89	2.44	0.89	3.33	0.33	11.11	2.22	1.44
Oregon	41	31.33	1.44	5.89	2.44	0.89	3.44	5.33	7.89	1.67	1.56
Pennsylvania	42	27.67	3.89	6.44	3.11	1.00	3.89	1.00	4.89	2.22	0.67
Rhode Island	44	26.44	3.67	6.11	3.00	1.00	3.78	18.56	10.22	9.11	0.00
South Carolina	45	36.00	1.11	4.56	1.78	1.44	1.89	51.67	7.89	20.67	0.00
South Dakota	46	32.44	1.11	4.22	1.67	1.44	1.78	29.11	18.33	19.11	0.00
Tennessee	47	32.00	1.00	4.11	1.56	1.33	1.78	13.89	7.00	31.33	1.44
Texas	48	29.33	1.11	4.33	1.67	1.44	1.78	8.78	0.89	2.89	0.67
Utah	49	20.78	1.00	3.89	1.56	1.33	1.67	20.44	1.44	4.22	1.33
Vermont	50	28.00	1.00	3.67	1.56	1.22	1.56	36.33	4.67	26.11	0.00
Virginia	51	27.78	1.00	4.11	1.56	1.33	1.78	19.22	9.56	0.33	0.00
Washington	53	15.89	1.00	3.78	1.56	1.22	1.56	24.67	9.00	16.33	0.00
West Virginia	54	30.78	2.44	4.44	2.11	0.67	2.22	16.33	11.56	7.11	0.00
Wisconsin	55	31.44	2.44	4.44	2.11	0.67	2.22	21.89	3.56	11.44	0.67
Wyoming	56	17.56	2.33	4.22	2.00	0.67	2.11	0.00	0.00	0.00	0.00

Table 43. Milk rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	34.33	0.03	0.01	0.02
2	39.21	0.05	0.01	0.01
3	35.97	0.04	0.01	0.02
4	37.52	0.04	0.01	0.02
5	42.69	0.04	0.01	0.04
6	38.81	0.05	0.01	0.01
7	36.80	0.05	0.01	0.03
8	35.61	0.04	0.01	0.03
9	37.31	0.04	0.01	0.03
10	35.35	0.04	0.01	0.02
11	36.44	0.03	0.01	0.01
12	36.33	0.04	0.01	0.02
13	36.92	0.04	0.01	0.02
14	35.81	0.04	0.02	0.02
15	35.69	0.04	0.01	0.02
16	38.01	0.04	0.02	0.02
17	35.36	0.04	0.01	0.03
18	36.66	0.04	0.01	0.02
19	35.36	0.03	0.02	0.02
20	35.35	0.03	0.02	0.02
21	38.54	0.04	0.02	0.01
22	30.86	0.04	0.01	0.01
23	39.89	0.04	0.01	0.03
24	40.51	0.05	0.01	0.01
25	29.66	0.03	0.01	0.01
26	37.82	0.04	0.01	0.03
27	26.28	0.03	0.02	0.01
28	40.31	0.04	0.01	0.04
29	23.63	0.03	0.02	0.01
30	41.26	0.04	0.01	0.04
31	41.70	0.04	0.01	0.04
Average	37.09	0.04	0.01	0.02

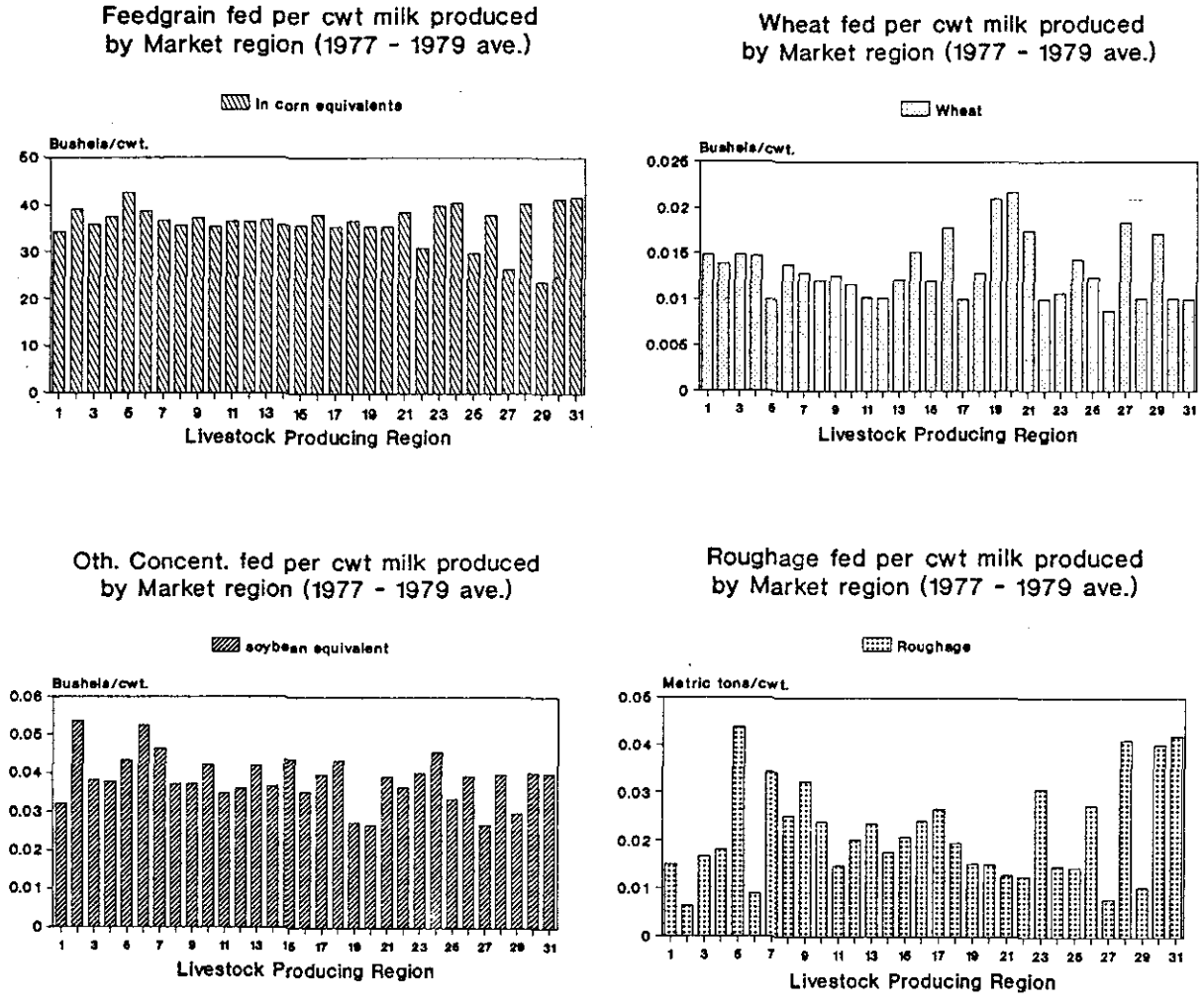

Figure 11. Rations required in the production of milk by livestock producing area

the feed ration. Information on feed for hens, pullets, and chickens are aggregated together.

Chicken feed consumption includes consumption by meat producing and egg laying hens. Thus, feed consumption by chickens is not totally aggregated into the egg category. Rather, it is split between eggs and broilers. The average percent of broiler type hatching of all eggs hatched during the time period of concern is used to supply the weight (Table 44).

After aggregating the USDA level feed concentrate information for hens, pullets, and the proportion of chickens that are destined to be egg laying hens, the values are weighted to state (Table 45). They are then multiplied by projected production (see Table 38) and aggregated to livestock producing regions. Table 46 and Figure 12 illustrate the livestock producing area rations. Once again, the feedgrains barley, corn, oats, and sorghum are aggregated together using:

$$FGMRFU = C + (S + 0.95) + (O + 0.90) + (B * 0.80)$$

where: C, S, O, and B have been previously defined.

Broilers

It is decided that the 1975-1977 period would be sufficient to estimate broiler feed demands. Broiler feed consumption, along with that proportion of chicken feed consumption allocated to the broiler industry are summed together. Total USDA feed consumption is then disaggregated to the state level using estimates on broiler production (Table 47). These estimates are then weighted to market region by first multiplying the rations by state projections (see Table 31) and then by

Table 44. The percent of broiler type hatchings of total eggs hatched by state, 1975-1977 average

State	Average	State	Average
Alabama	.972	Tennessee	.735[a]
Arkansas	.957	Texas	.885
California	.707	Utah	.127
Connecticut	.475	Virgina	.926
Delaware	.986[a]	Washington	.683
Florida	.688	Colorado	.576[a]
Georgia	.916	Idaho	.576[a]
Illinois	.007[a]	Kentucky	.577[a]
Indiana	.371	Louisiana	.945[a]
Iowa	.104[a]	Massachusetts	.504[a]
Kansas	.997	Montana	.576[a]
Maine	.861	New Hampshire	.564[a]
Maryland	.992[a]	New Jersey	.576[a]
Michigan	.200[a]	North Dakota	.576[a]
Minnesota	.408	Ohio	.333[a]
Mississippi	.947	Rhode Island	.504[a]
Missouri	.403[a]	South Dakota	.576[a]
Nebraska	.517	West Virginia	.474[a]
New York	.096[a]	Wisconsin	.671[a]
North Carolina	.979	Wyoming	.576[a]
Oklahoma	.456	Arizona	.576[a]
Oregon	.727	Nevada	.046[a]
Pennsylvania	.817	New Mexico	.576[a]
South Carolina	.749	Vermont	.564[a]

[a]1971-1973 average.

Table 45. Feedstuffs required for egg production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per 100)									
Alabama	1	23.30	0.00	7.03	1.27	2.64	5.67	0.00	0.00	0.00	0.00
Arizona	4	26.73	0.00	8.08	1.46	3.04	6.56	0.00	0.00	0.00	0.00
Arkansas	5	26.93	0.00	8.13	1.47	3.07	6.56	0.00	0.00	0.00	0.00
California	6	25.67	0.00	7.76	1.39	2.92	6.22	0.00	0.00	0.00	0.00
Colorado	8	24.62	0.00	7.43	1.33	2.80	6.00	0.00	0.00	0.00	0.00
Connecticut	9	25.50	0.00	7.70	1.38	2.90	6.22	0.00	0.00	0.00	0.00
Delaware	10	26.43	0.00	7.98	1.43	3.01	6.44	0.00	0.00	0.00	0.00
Florida	12	28.27	0.00	8.53	1.53	3.21	6.89	0.00	0.00	0.00	0.00
Georgia	13	26.91	0.00	8.13	1.47	3.06	6.56	0.00	0.00	0.00	0.00
Idaho	16	25.63	0.00	7.74	1.39	2.91	6.22	0.00	0.00	0.00	0.00
Illinois	17	25.29	0.00	7.63	1.38	2.88	6.22	0.00	0.00	0.00	0.00
Indiana	18	25.00	0.00	6.67	1.39	2.67	3.56	0.00	0.00	0.00	0.00
Iowa	19	21.33	4.11	3.67	1.22	2.56	3.00	0.00	0.00	0.00	0.00
Kansas	20	15.79	7.78	4.56	1.22	2.11	3.56	0.00	0.00	0.00	0.00
Kentucky	21	26.78	1.19	3.47	0.88	1.93	3.22	0.00	0.00	0.00	0.00
Louisiana	22	25.44	1.16	3.38	0.86	1.89	3.11	0.00	0.00	0.00	0.00
Maine	23	14.48	1.21	3.54	0.90	1.98	3.33	0.00	0.00	0.00	0.00
Maryland	24	14.26	1.19	3.48	0.89	1.94	3.22	0.00	0.00	0.00	0.00
Massachusetts	25	14.31	1.19	3.50	0.89	1.96	3.22	0.00	0.00	0.00	0.00
Michigan	26	23.22	0.00	6.56	0.72	1.23	2.33	0.00	0.00	0.00	0.00
Minnesota	27	24.56	0.00	7.44	1.44	2.67	3.44	0.00	0.00	0.00	0.00
Mississippi	28	26.34	5.67	5.33	1.56	3.22	4.44	0.00	0.00	0.00	0.00
Missouri	29	23.33	5.22	4.11	1.44	2.78	3.44	0.00	0.00	0.00	0.00
Montana	30	23.67	0.00	8.67	1.44	3.11	3.67	0.00	0.00	0.00	0.00
Nebraska	31	11.81	2.17	2.24	0.67	1.32	2.78	0.00	0.00	0.00	0.00
Nevada	32	22.00	2.34	2.42	0.72	1.42	3.00	0.00	0.00	0.00	0.00
New Hampshire	33	11.68	2.14	2.21	0.66	1.30	2.67	0.00	0.00	0.00	0.00
New Jersey	34	12.32	2.26	2.34	0.69	1.38	2.89	0.00	0.00	0.00	0.00
New Mexico	35	15.22	8.56	4.67	1.22	2.44	3.33	0.00	0.00	0.00	0.00
New York	36	22.67	1.40	1.94	0.51	1.09	2.22	0.00	0.00	0.00	0.00
North Carolina	37	24.56	5.22	5.11	1.44	2.78	4.11	0.00	0.00	0.00	0.00
North Dakota	38	25.56	0.00	7.11	1.56	3.67	4.11	0.00	0.00	0.00	0.00
Ohio	39	25.33	0.00	6.89	1.22	2.56	3.67	0.00	0.00	0.00	0.00

Table 45. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per 100)									
Oklahoma	40	17.22	9.89	4.44	1.44	2.78	3.89	0.00	0.00	0.00	0.00
Oregon	41	32.44	0.00	8.44	1.78	3.67	4.56	0.00	0.00	0.00	0.00
Pennsylvania	42	25.44	0.00	8.00	1.44	2.78	3.89	0.00	0.00	0.00	0.00
Rhode Island	44	26.67	0.00	9.89	1.44	2.44	4.22	0.00	0.00	0.00	0.00
South Carolina	45	16.07	5.17	4.18	1.14	6.16	4.22	0.00	0.00	0.00	0.00
South Dakota	46	15.31	4.92	3.99	1.10	5.86	4.00	0.00	0.00	0.00	0.00
Tennessee	47	15.17	4.88	3.94	1.09	5.81	4.00	0.00	0.00	0.00	0.00
Texas	48	16.76	10.44	3.19	0.88	4.70	3.22	0.00	0.00	0.00	0.00
Utah	49	14.46	4.64	3.76	1.03	5.53	3.78	0.00	0.00	0.00	0.00
Vermont	50	15.52	5.00	4.03	1.11	5.94	4.00	0.00	0.00	0.00	0.00
Virginia	51	14.90	4.80	3.88	1.07	5.71	3.89	0.00	0.00	0.00	0.00
Washington	53	12.84	4.13	3.33	0.91	4.92	3.33	0.00	0.00	0.00	0.00
West Virginia	54	25.67	0.00	8.00	1.39	2.33	3.78	0.00	0.00	0.00	0.00
Wisconsin	55	25.11	0.00	7.44	1.22	2.56	3.78	0.00	0.00	0.00	0.00
Wyoming	56	22.11	0.00	5.89	1.22	2.44	3.11	0.00	0.00	0.00	0.00

Table 46. Egg rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per hundred eggs).....			(tons/(00) eggs)
1	125.105	1.012	0.408	0.000
2	69.923	0.673	0.487	0.000
3	61.228	0.317	0.388	0.000
4	59.666	0.677	0.387	0.000
5	95.527	1.579	1.344	0.000
6	52.334	0.316	0.447	0.000
7	27.894	0.128	0.627	0.000
8	51.416	0.262	0.984	0.000
9	50.664	1.197	0.572	0.000
10	29.703	0.059	0.051	0.000
11	34.501	0.195	0.135	0.000
12	45.768	0.534	0.267	0.000
13	61.837	0.920	0.495	0.000
14	49.903	0.563	0.414	0.000
15	44.215	0.545	0.033	0.000
16	82.507	0.761	0.929	0.000
17	65.405	1.129	0.023	0.000
18	40.374	0.683	0.246	0.000
19	83.801	0.519	1.548	0.000
20	83.090	0.548	1.570	0.000
21	33.458	0.117	0.244	0.000
22	28.925	0.054	0.046	0.000
23	100.497	0.426	0.043	0.000
24	31.159	0.085	0.046	0.000
25	35.511	0.259	0.230	0.000
26	85.068	0.423	0.861	0.000
27	155.889	1.383	0.585	0.000
28	81.957	0.702	0.198	0.000
29	36.708	0.394	0.293	0.000
30	94.273	0.594	0.877	0.000
31	94.270	0.593	0.877	0.000
Average	63.715	0.666	0.545	0.000

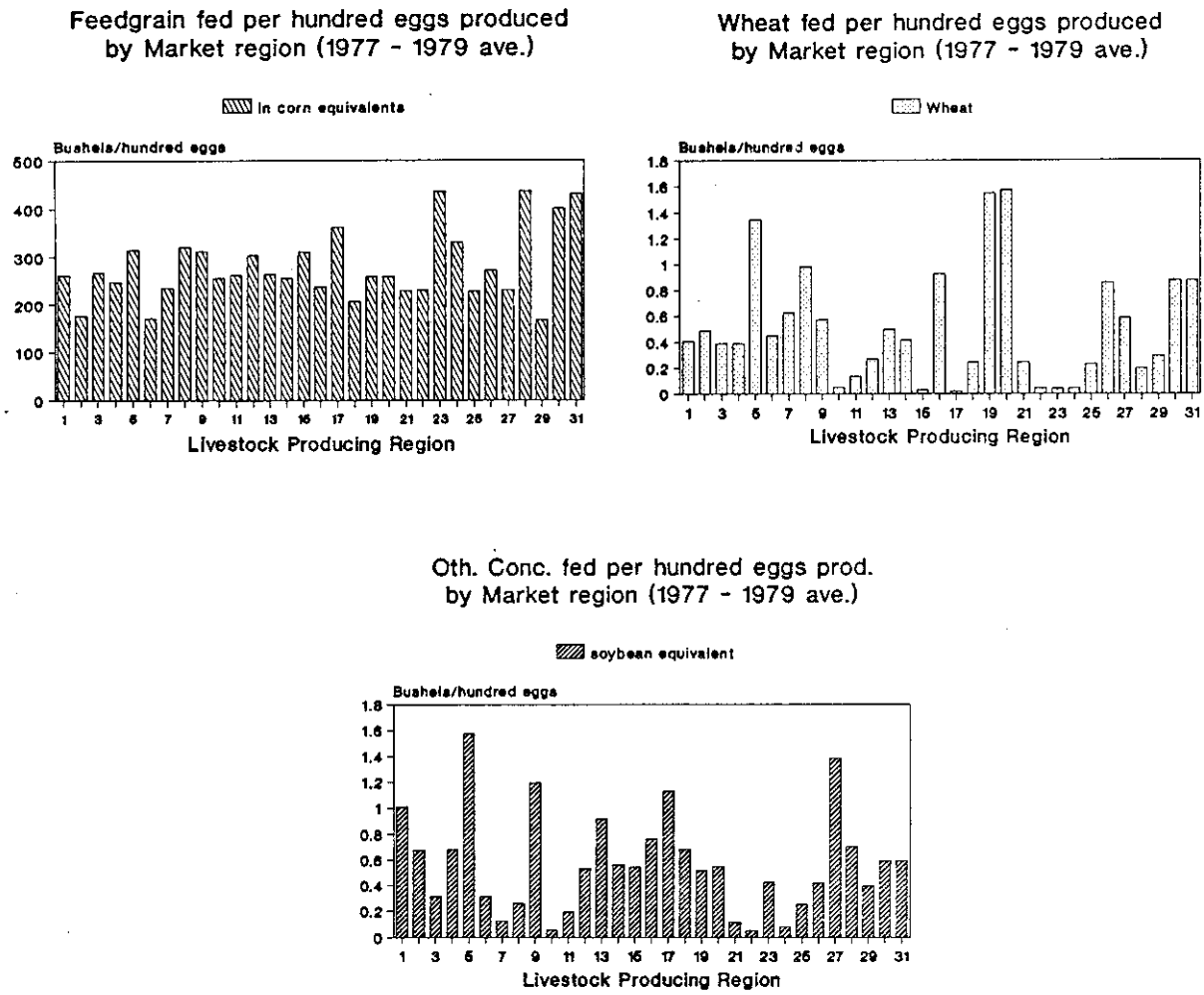

Figure 12. Rations required in the production of eggs by livestock producing area

Table 47. Feedstuffs required for broiler production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Alabama	1	132.33	0.00	5.56	0.78	6.89	43.44	0.00	0.00	0.00	0.00
Arizona	4	151.00	12.67	7.44	1.56	8.78	34.67	0.00	0.00	0.00	0.00
Arkansas	5	134.11	12.56	4.11	1.11	7.00	33.89	0.00	0.00	0.00	0.00
California	6	106.33	43.78	5.78	2.11	11.56	33.89	0.00	0.00	0.00	0.00
Colorado	8	151.00	12.67	7.44	1.56	8.78	34.67	0.00	0.00	0.00	0.00
Connecticut	9	131.56	0.00	11.56	1.67	14.56	36.22	0.00	0.00	0.00	0.00
Delaware	10	188.33	0.00	7.89	1.00	9.89	61.89	0.00	0.00	0.00	0.00
Florida	12	157.11	0.00	14.67	2.00	10.44	33.11	0.00	0.00	0.00	0.00
Georgia	13	132.78	0.00	5.56	0.78	6.89	43.56	0.00	0.00	0.00	0.00
Idaho	16	136.33	0.00	5.67	0.78	7.11	44.78	0.00	0.00	0.00	0.00
Illinois	17	140.56	0.00	5.89	0.78	7.44	46.22	0.00	0.00	0.00	0.00
Indiana	18	129.00	0.00	46.00	7.56	34.44	29.56	0.00	0.00	0.00	0.00
Iowa	19	122.89	0.00	37.00	6.11	27.89	26.67	0.00	0.00	0.00	0.00
Kansas	20	63.11	50.44	12.11	3.78	16.00	26.89	0.00	0.00	0.00	0.00
Kentucky	21	142.00	10.11	13.22	2.89	14.67	47.56	0.00	0.00	0.00	0.00
Louisiana	22	164.78	11.78	15.33	3.33	17.00	55.22	0.00	0.00	0.00	0.00
Maine	23	187.89	0.00	9.89	1.22	8.00	40.22	0.00	0.00	0.00	0.00
Maryland	24	141.11	10.11	13.11	2.89	14.56	47.33	0.00	0.00	0.00	0.00
Massachusetts	25	158.89	11.44	14.78	3.22	16.33	53.33	0.00	0.00	0.00	0.00
Michigan	26	151.00	12.67	7.44	1.56	8.78	34.56	0.00	0.00	0.00	0.00
Minnesota	27	145.67	0.00	25.67	3.33	18.22	31.78	0.00	0.00	0.00	0.00
Mississippi	28	132.56	10.67	2.33	0.67	6.00	29.44	0.00	0.00	0.00	0.00
Missouri	29	120.89	17.11	4.00	1.33	9.78	57.78	0.00	0.00	0.00	0.00
Montana	30	151.00	8.44	2.22	0.67	4.89	35.44	0.00	0.00	0.00	0.00
Nebraska	31	118.44	9.67	2.44	0.78	5.67	40.67	0.00	0.00	0.00	0.00
Nevada	32	106.44	8.67	2.33	0.67	5.11	36.44	0.00	0.00	0.00	0.00
New Hampshire	33	113.67	9.33	2.33	0.78	5.44	39.00	0.00	0.00	0.00	0.00
New Jersey	34	136.89	11.22	2.89	0.89	6.56	46.89	0.00	0.00	0.00	0.00
New Mexico	35	126.67	8.89	2.67	0.67	5.89	43.78	0.00	0.00	0.00	0.00
New York	36	124.11	8.67	2.56	0.67	5.67	42.89	0.00	0.00	0.00	0.00
North Carolina	37	107.00	7.56	2.22	0.56	4.89	37.00	0.00	0.00	0.00	0.00
North Dakota	38	118.89	8.22	2.44	0.67	5.56	41.11	0.00	0.00	0.00	0.00
Ohio	39	136.56	9.22	2.00	0.67	5.56	39.89	0.00	0.00	0.00	0.00

Table 47. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Oklahoma	40	158.67	9.22	2.00	0.67	5.56	47.33	0.00	0.00	0.00	0.00
Oregon	41	108.44	9.67	2.11	0.78	5.89	41.89	0.00	0.00	0.00	0.00
Pennsylvania	42	164.22	21.22	1.67	0.67	6.22	41.56	0.00	0.00	0.00	0.00
Rhode Island	44	89.67	22.78	1.78	0.78	6.78	44.89	0.00	0.00	0.00	0.00
South Carolina	45	156.44	23.56	9.89	2.89	14.11	38.11	0.00	0.00	0.00	0.00
South Dakota	46	151.00	12.11	7.44	1.56	8.78	34.67	0.00	0.00	0.00	0.00
Tennessee	47	145.00	13.11	3.33	1.11	7.33	31.33	0.00	0.00	0.00	0.00
Texas	48	113.00	23.78	3.78	1.00	7.78	37.44	0.00	0.00	0.00	0.00
Utah	49	151.11	12.67	7.44	1.56	8.78	34.67	0.00	0.00	0.00	0.00
Vermont	50	151.00	12.78	7.44	1.56	8.78	48.78	0.00	0.00	0.00	0.00
Virginia	51	150.56	14.22	4.22	1.11	8.33	31.78	0.00	0.00	0.00	0.00
Washington	53	143.00	0.00	14.00	2.22	11.67	32.22	0.00	0.00	0.00	0.00
West Virginia	54	121.56	39.33	6.00	2.11	13.00	52.44	0.00	0.00	0.00	0.00
Wisconsin	55	151.00	29.78	4.56	1.67	9.78	34.67	0.00	0.00	0.00	0.00
Wyoming	56	107.11	34.56	5.33	1.89	11.44	46.22	0.00	0.00	0.00	0.00

the state-to-livestock producing area weights shown in Table 37. Table 48 and Figure 13 contain the results of this process. The conversion of the feedgrain to feedgrain units is done in a manner similar to that used in chicken production.

Turkeys

Turkey concentrate feed consumption is based on 1975-1977 data. The feed concentrate data is disaggregated to the state level using state turkey production data collected from the 1980 Agricultural Statistics (USDA, 1982) (Table 49). The state rations are then multiplied by the projected level of turkey production provided by the NIRAP system (See Table 38). These data are then weighted to the livestock producing area and rations are developed (Table 50 and Figure 14).

Sheep

The final livestock category of concern is sheep production. The USDA feed concentrate estimates used by the sheep industry in 1975 through 1977 is used as the initial base. Then data are weighted first to state (Table 51) and then to livestock producing area (Table 52 and Figure 15) using a method identical to those previously presented.

Water Requirements

The water requirements for livestock production are presented in Table 53. These data when multiplied by production provide the quantity of water required by livestock per day. Required production up to now is at the livestock producing area. Water requirements vs. ARIMS are

Table 48. Broiler rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	177.790	0.604	0.120	0.000
2	168.126	0.653	0.098	0.000
3	145.301	0.683	0.150	0.000
4	122.030	0.579	0.100	0.000
5	153.665	0.502	0.155	0.000
6	120.658	0.579	0.079	0.000
7	148.889	0.513	0.283	0.000
8	152.024	0.541	0.312	0.000
9	125.995	0.640	0.106	0.000
10	154.297	0.477	0.273	0.000
11	166.191	0.520	0.147	0.000
12	144.345	0.419	0.398	0.000
13	135.077	0.530	0.108	0.000
14	136.856	0.514	0.112	0.000
15	127.885	0.705	0.186	0.000
16	136.288	0.477	0.295	0.000
17	116.985	0.592	0.098	0.000
18	136.684	0.545	0.105	0.000
19	131.981	0.596	0.135	0.000
20	125.810	0.562	0.117	0.000
21	NE	NE	NE	NE
22	NE	NE	NE	NE
23	117.399	0.610	0.085	0.000
25	127.762	0.671	0.106	0.000
26	127.860	0.672	0.107	0.000
27	153.980	0.520	0.132	0.000
28	NE	NE	NE	NE
29	125.042	0.555	0.132	0.000
30	139.330	0.508	0.173	0.000
31	139.330	0.508	0.173	0.000
Average	136.636	0.592	0.122	0.000

NE indicates no estimate is available

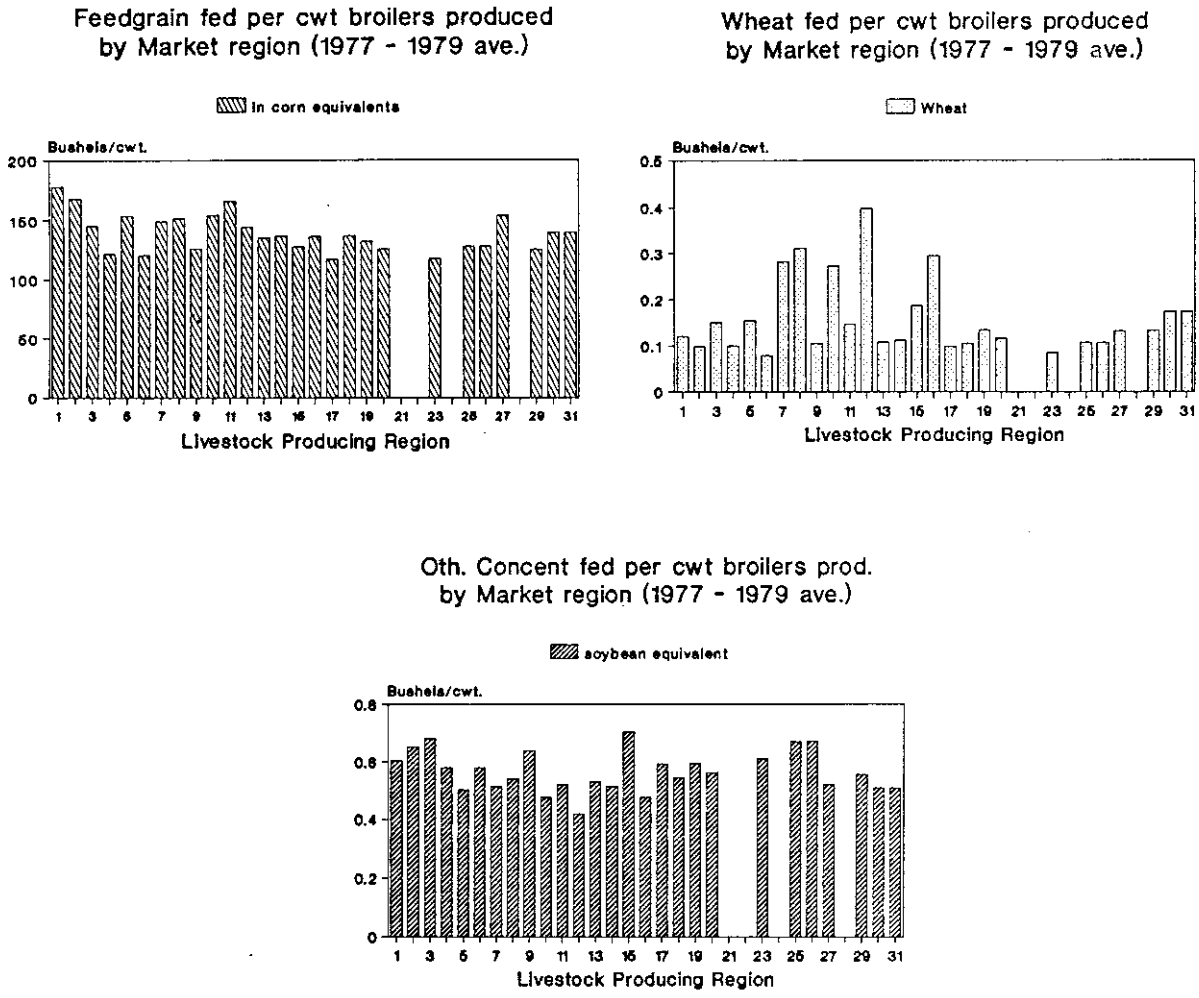

Figure 13. Rations required in the production of broilers by livestock producing area

Table 49. Feedstuffs required for turkey production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Alabama	1	287.22	0.00	0.00	13.00	49.44	34.56	0.00	0.00	0.00	0.00
Arizona	4	156.89	0.00	0.00	7.00	27.00	51.33	0.00	0.00	0.00	0.00
Arkansas	5	192.33	0.00	0.00	8.67	33.11	63.00	0.00	0.00	0.00	0.00
California	6	186.89	64.33	0.00	8.44	32.22	61.22	0.00	0.00	0.00	0.00
Colorado	8	146.44	0.00	0.00	6.56	25.22	48.00	0.00	0.00	0.00	0.00
Connecticut	9	246.67	0.00	0.00	11.11	42.44	48.33	0.00	0.00	0.00	0.00
Delaware	10	197.78	0.00	0.00	8.89	34.11	64.78	0.00	0.00	0.00	0.00
Florida	12	176.33	22.11	0.00	8.00	30.44	57.78	0.00	0.00	0.00	0.00
Georgia	13	208.56	0.00	0.00	6.44	24.89	47.22	0.00	0.00	0.00	0.00
Idaho	16	213.78	22.11	0.00	5.56	35.11	48.78	0.00	0.00	0.00	0.00
Illinois	17	139.11	0.00	0.00	6.22	23.89	45.56	0.00	0.00	0.00	0.00
Indiana	18	211.11	0.00	0.00	10.11	35.78	63.67	0.00	0.00	0.00	0.00
Iowa	19	184.11	0.00	0.00	8.78	31.22	55.56	0.00	0.00	0.00	0.00
Kansas	20	193.89	0.00	0.00	9.22	32.89	58.56	0.00	0.00	0.00	0.00
Kentucky	21	152.44	12.11	0.00	4.33	28.11	48.00	0.00	0.00	0.00	0.00
Louisiana	22	213.78	11.00	0.00	4.00	25.56	43.56	0.00	0.00	0.00	0.00
Maine	23	213.78	11.22	0.00	4.11	25.89	44.22	0.00	0.00	0.00	0.00
Maryland	24	213.78	10.67	0.00	3.78	24.56	42.11	0.00	0.00	0.00	0.00
Massachusetts	25	234.44	10.67	0.00	3.78	24.56	42.00	0.00	0.00	0.00	0.00
Michigan	26	146.56	20.22	0.00	4.67	29.67	54.44	0.00	0.00	0.00	0.00
Minnesota	27	213.78	18.33	0.00	4.22	26.89	49.44	0.00	0.00	0.00	0.00
Mississippi	28	181.56	25.11	0.00	5.78	36.67	67.44	0.00	0.00	0.00	0.00
Missouri	29	180.56	24.89	0.00	5.78	36.44	36.11	0.00	0.00	0.00	0.00
Montana	30	166.22	17.22	0.00	2.78	27.00	56.22	0.00	0.00	0.00	0.00
Nebraska	31	160.89	16.67	0.00	2.67	26.11	54.44	0.00	0.00	0.00	0.00
Nevada	32	171.22	17.67	0.00	2.78	27.89	58.00	0.00	0.00	0.00	0.00
New Hampshire	33	219.78	22.67	0.00	3.56	35.67	74.33	0.00	0.00	0.00	0.00
New Jersey	34	213.78	36.89	0.00	5.89	58.00	48.78	0.00	0.00	0.00	0.00
New Mexico	35	213.78	12.11	0.00	1.67	18.00	46.22	0.00	0.00	0.00	0.00
New York	36	162.89	15.78	0.00	2.11	23.44	60.11	0.00	0.00	0.00	0.00
North Carolina	37	213.78	23.22	0.00	5.56	30.89	42.89	0.00	0.00	0.00	0.00
North Dakota	38	221.67	9.11	0.00	1.22	13.67	35.00	0.00	0.00	0.00	0.00
Ohio	39	227.22	0.00	0.00	9.22	29.67	45.56	0.00	0.00	0.00	0.00

Table 49. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Oklahoma	40	174.11	13.11	0.00	1.67	19.00	51.89	0.00	0.00	0.00	0.00
Oregon	41	117.67	12.00	0.00	1.33	17.33	47.67	0.00	0.00	0.00	0.00
Pennsylvania	42	146.00	47.56	0.00	3.00	35.33	70.67	0.00	0.00	0.00	0.00
Rhode Island	44	213.78	37.00	0.00	2.33	27.56	55.00	0.00	0.00	0.00	0.00
South Carolina	45	172.67	16.00	0.00	2.22	24.00	40.89	0.00	0.00	0.00	0.00
South Dakota	46	243.44	5.89	0.00	0.44	17.44	53.11	0.00	0.00	0.00	0.00
Tennessee	47	213.78	22.11	0.00	5.56	35.11	48.78	0.00	0.00	0.00	0.00
Texas	48	160.78	42.22	0.00	1.44	51.78	52.33	0.00	0.00	0.00	0.00
Utah	49	185.67	19.11	0.00	2.56	26.22	39.22	0.00	0.00	0.00	0.00
Vermont	50	213.78	5.89	0.00	0.44	17.44	48.78	0.00	0.00	0.00	0.00
Virginia	51	213.78	21.78	0.00	1.67	64.11	34.78	0.00	0.00	0.00	0.00
Washington	53	213.78	23.22	0.00	5.56	35.11	48.78	0.00	0.00	0.00	0.00
West Virginia	54	194.22	70.44	0.00	4.89	51.67	42.89	0.00	0.00	0.00	0.00
Wisconsin	55	150.78	54.67	0.00	3.78	40.11	65.22	0.00	0.00	0.00	0.00
Wyoming	56	128.00	46.33	0.00	3.22	34.00	55.33	0.00	0.00	0.00	0.00

Table 50. Turkey rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	223.744	0.813	0.518	0.000
2	175.089	1.053	0.535	0.000
3	216.326	0.604	0.642	0.000
4	198.936	0.639	0.421	0.000
5	183.203	0.865	0.459	0.000
6	200.318	0.766	0.450	0.000
7	179.137	0.789	0.458	0.000
8	192.344	0.935	0.524	0.000
9	255.203	0.579	0.700	0.000
10	209.377	0.753	0.413	0.000
11	195.972	0.878	0.517	0.000
12	171.994	0.833	0.468	0.000
13	180.132	0.908	0.501	0.000
14	198.692	0.795	0.450	0.000
15	187.109	0.557	0.543	0.000
16	223.181	0.791	0.262	0.000
17	160.986	0.817	0.393	0.000
18	178.932	0.897	0.478	0.000
19	181.841	0.785	0.777	0.000
20	181.840	0.785	0.777	0.000
21	203.916	0.692	0.270	0.000
22	NE	NE	NE	NE
23	136.521	0.720	0.378	0.000
24	203.958	0.693	0.270	0.000
25	216.233	0.732	0.526	0.000
26	215.502	0.731	0.528	0.000
27	185.280	0.588	0.393	0.000
28	146.241	0.771	0.404	0.000
29	128.094	0.717	0.290	0.000
30	229.285	0.918	0.483	0.000
31	229.285	0.918	0.483	0.000
Average	196.522	0.755	0.508	0.000

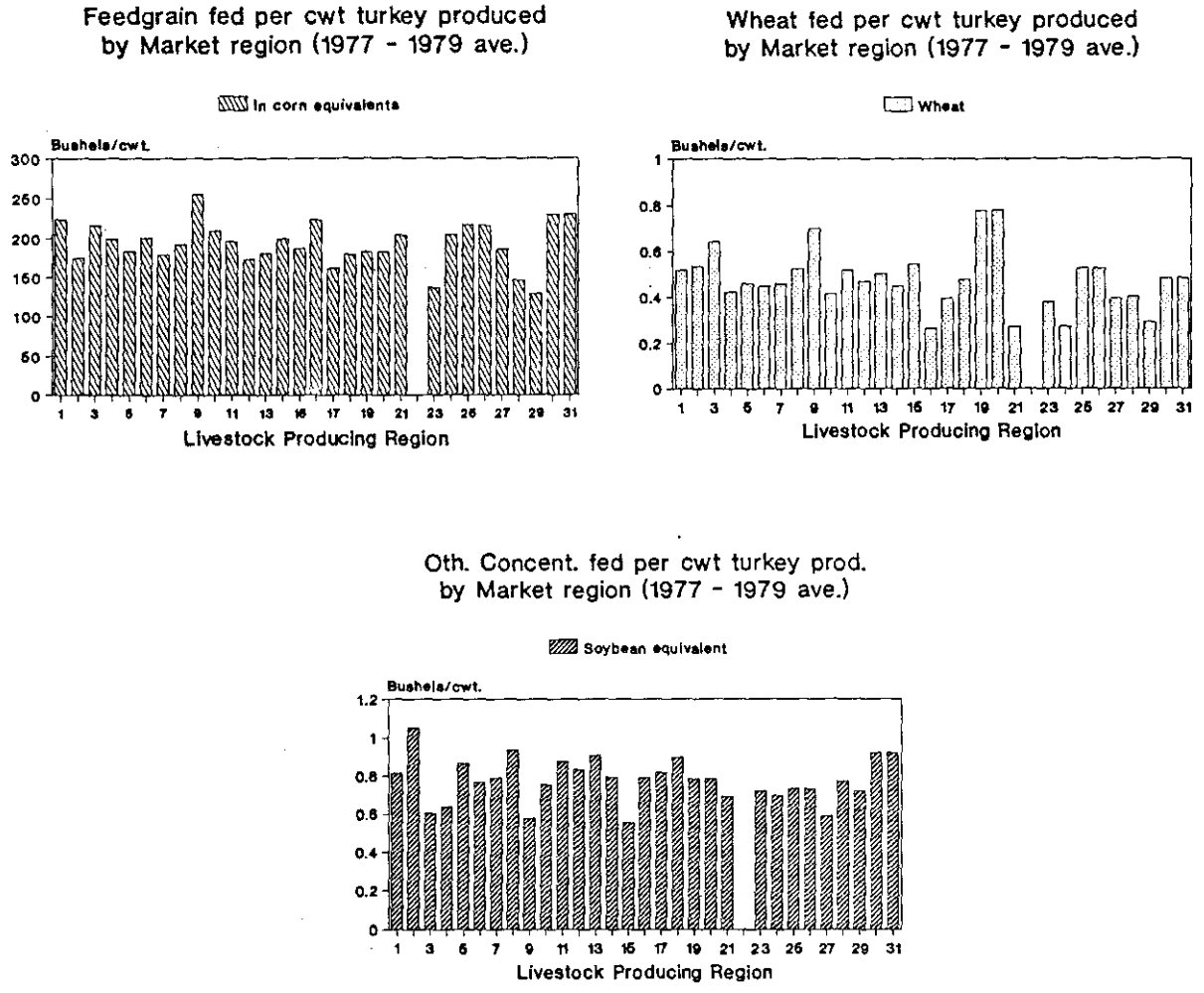

Figure 14. Rations required in the production of turkey by livestock producing area

Table 51. Feedstuffs required for sheep production, by state

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Alabama	1	42.11	0.00	29.78	5.56	1.56	54.89	264.56	719.11	0.00	0.00
Arizona	4	80.44	0.00	21.44	4.11	1.00	74.67	883.56	904.00	0.00	0.00
Arkansas	5	42.11	0.00	23.67	4.44	1.11	54.89	269.00	1076.00	0.00	0.00
California	6	43.11	0.00	24.44	4.56	1.22	84.89	255.56	300.00	0.00	0.00
Colorado	8	25.67	0.00	28.44	5.22	1.44	40.89	389.00	932.56	0.00	0.00
Connecticut	9	42.11	0.00	24.00	4.44	1.11	54.89	1522.33	1497.56	0.00	0.00
Delaware	10	42.11	1.33	27.67	6.56	2.44	54.89	791.22	562.89	0.00	0.00
Florida	12	42.11	0.00	28.89	5.44	1.44	54.89	1093.56	919.78	0.00	0.00
Georgia	13	42.11	0.00	28.44	5.33	1.44	54.89	453.67	512.78	0.00	0.00
Idaho	16	18.78	0.00	23.89	4.44	1.11	21.78	355.44	606.44	0.00	0.00
Illinois	17	93.78	0.00	25.00	4.67	1.22	86.89	1424.00	0.00	0.00	0.00
Indiana	18	91.78	2.11	29.33	8.33	3.33	108.78	1624.22	0.00	0.00	0.00
Iowa	19	67.89	1.00	27.44	6.89	2.33	74.44	1471.67	0.00	0.00	0.00
Kansas	20	50.67	2.11	29.11	8.33	3.22	87.89	156.22	167.33	0.00	0.00
Kentucky	21	48.56	8.67	21.22	8.78	2.67	57.78	270.78	194.44	0.00	0.00
Louisiana	22	42.11	8.22	22.67	8.33	2.11	54.89	865.44	0.00	0.00	0.00
Maine	23	42.11	9.22	24.00	9.33	2.56	54.89	1104.00	0.00	0.00	0.00
Maryland	24	131.78	9.33	23.11	9.44	2.78	93.33	126.22	1487.00	0.00	0.00
Massachusetts	25	42.11	9.78	23.33	9.89	3.00	54.89	518.78	290.78	0.00	0.00
Michigan	26	80.00	12.56	11.44	7.00	2.56	102.11	160.44	75.44	0.00	0.00
Minnesota	27	78.56	8.78	9.44	4.22	1.00	88.22	1032.44	423.89	0.00	0.00
Mississippi	28	42.11	13.33	10.22	8.56	3.78	43.33	459.89	289.67	0.00	0.00
Missouri	29	65.11	11.44	11.33	6.22	1.89	79.33	0.00	414.78	0.00	0.00
Montana	30	32.22	5.56	17.44	5.56	0.89	37.78	0.00	340.56	0.00	0.00
Nebraska	31	32.11	5.78	18.11	5.78	1.00	51.89	0.00	719.11	0.00	0.00
Nevada	32	73.22	5.33	16.67	5.33	0.89	63.78	0.00	1487.00	0.00	0.00
New Hampshire	33	42.11	6.89	21.67	6.89	1.11	54.89	0.00	1487.00	0.00	0.00
New Jersey	34	42.11	6.89	21.89	6.89	1.11	54.89	0.00	0.00	0.00	0.00
New Mexico	35	65.00	31.44	26.78	10.22	1.44	110.22	0.00	0.00	0.00	0.00
New York	36	85.44	0.00	27.78	4.78	1.22	102.89	0.00	0.00	0.00	0.00
North Carolina	37	42.11	8.33	14.22	4.22	1.22	54.89	0.00	0.00	0.00	0.00
North Dakota	38	40.11	0.00	14.00	0.00	0.78	45.67	0.00	0.00	0.00	0.00
Ohio	39	86.00	0.00	27.33	4.78	1.33	99.44	0.00	0.00	0.00	0.00

Table 51. Continued

State Name	State Number	Corn	Sorghum	Oats	Barley	Wheat	Oilmeal	Legume Hay	Other Hay	Corn Silage	Sorghum Silage
		(pounds per liveweight hundred weight)									
Oklahoma	40	46.33	22.78	17.00	7.44	1.00	76.56	0.00	0.00	0.00	0.00
Oregon	41	26.11	0.00	8.67	1.56	0.44	29.00	550.89	814.22	0.00	0.00
Pennsylvania	42	59.56	16.33	6.22	5.78	2.00	92.11	0.00	141.33	0.00	0.00
Rhode Island	44	36.44	13.44	5.56	4.11	1.00	54.89	235.44	127.44	0.00	0.00
South Carolina	45	42.11	17.11	15.89	8.22	4.22	65.78	362.78	0.00	0.00	0.00
South Dakota	46	18.44	3.11	4.89	2.67	0.33	20.89	46.56	28.56	0.00	0.00
Tennessee	47	42.11	14.22	12.89	7.00	3.56	54.11	56.11	28.33	0.00	0.00
Texas	48	19.33	13.44	11.00	7.44	4.00	33.00	239.33	0.00	0.00	0.00
Utah	49	68.89	13.89	13.56	6.22	3.00	54.67	246.78	0.00	0.00	0.00
Vermont	50	42.11	13.89	11.22	7.67	4.33	50.11	226.22	0.00	0.00	0.00
Virginia	51	34.56	15.00	15.00	6.44	3.00	38.44	164.78	83.78	0.00	0.00
Washington	53	28.56	12.78	12.11	6.00	2.89	34.11	1050.78	381.33	0.00	0.00
West Virginia	54	78.11	36.22	20.22	11.78	3.00	92.67	115.44	81.67	0.00	0.00
Wisconsin	55	77.44	22.78	12.33	7.89	2.22	58.00	344.78	0.00	0.00	0.00
Wyoming	56	46.22	24.44	13.44	8.22	2.33	49.78	0.00	0.00	0.00	0.00

Table 52. Sheep rations estimated under current technology

Market Region	Feedgrain	Other Concentrate	Wheat	Roughage
	.....(bushels per cwt.)			(tons/cwt.)
1	66.486	0.812	0.037	0.415
2	87.605	1.418	0.024	0.302
3	82.399	0.836	0.044	0.243
4	60.896	0.612	0.044	0.115
5	62.954	0.823	0.021	0.561
6	99.875	1.408	0.026	0.130
7	99.556	1.521	0.031	0.205
8	96.631	1.314	0.045	0.393
9	64.351	0.799	0.040	0.335
10	70.757	1.025	0.014	0.070
11	101.450	1.001	0.029	0.100
12	92.654	1.145	0.030	0.462
13	87.150	1.164	0.023	0.395
14	64.095	0.733	0.043	0.336
15	77.085	1.106	0.029	0.386
16	30.769	0.388	0.007	0.135
17	59.813	0.958	0.028	0.323
18	76.001	1.155	0.028	0.205
19	43.249	0.495	0.060	0.035
20	43.249	0.495	0.060	0.035
21	62.462	0.809	0.050	0.025
22	67.490	0.670	0.026	0.153
23	55.224	0.649	0.025	0.205
24	88.934	1.159	0.020	0.230
25	50.580	0.561	0.013	0.175
26	37.375	0.331	0.016	0.382
27	87.606	0.836	0.038	0.142
28	91.031	1.117	0.015	0.399
29	31.541	0.437	0.008	0.003
30	61.198	1.215	0.017	0.508
31	59.967	1.273	0.018	0.550
Average	59.695	0.762	0.029	0.197

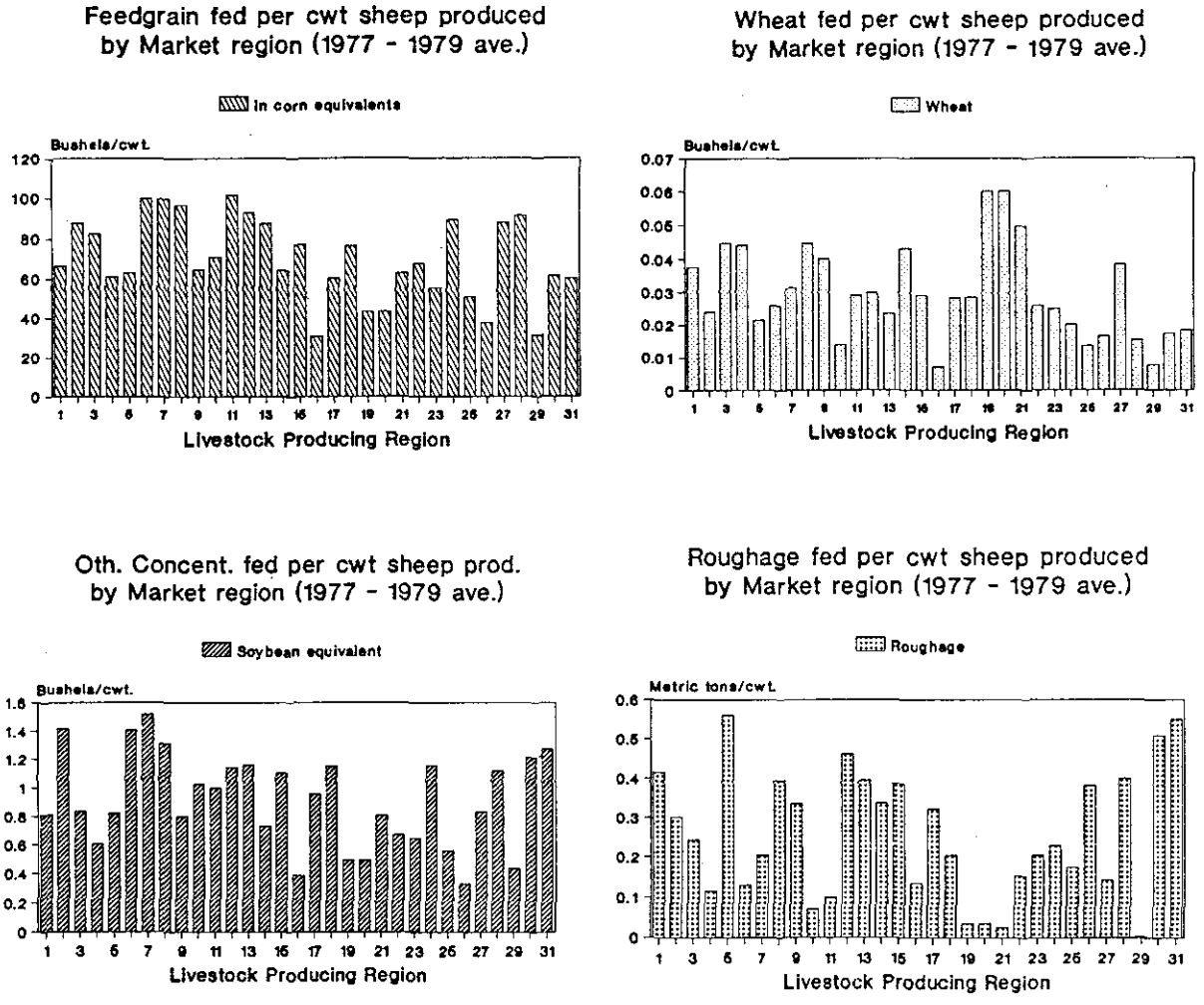

Figure 15. Rations required in the production of sheep by livestock production area

Table 53. Livestock water requirements by crop producing area

Crop Producing Area	Beef	Sheep	Pork	Chickens	Broilers	Turkeys	Eggs	Milk
	(Gallons per day per:)							
	(pounds of liveweight)						(1000)	(pound)
1	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
2	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
3	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
4	0.0150	0.0150	0.0105	0.0060	0.0021	0.0050	0.3900	0.0028
5	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
6	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
7	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
8	0.0150	0.0150	0.0135	0.0060	0.0021	0.0050	0.3900	0.0028
9	0.0150	0.0150	0.0120	0.0060	0.0021	0.0050	0.4300	0.0028
10	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.4300	0.0028
11	0.0150	0.0070	0.0105	0.0060	0.0025	0.0050	0.3900	0.0032
12	0.0250	0.0150	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
13	0.0250	0.0070	0.0090	0.0070	0.0032	0.0060	0.4300	0.0032
14	0.0250	0.0070	0.0090	0.0070	0.0032	0.0060	0.4300	0.0036
15	0.0250	0.0150	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
16	0.0350	0.0070	0.0120	0.0070	0.0032	0.0060	0.4300	0.0036
17	0.0350	0.0070	0.0135	0.0070	0.0032	0.0060	0.4300	0.0036
18	0.0250	0.0150	0.0105	0.0070	0.0032	0.0060	0.4300	0.0040
19	0.0250	0.0070	0.0105	0.0070	0.0032	0.0060	0.4300	0.0044
20	0.0250	0.0070	0.0105	0.0070	0.0032	0.0060	0.4300	0.0048
21	0.0250	0.0070	0.0120	0.0070	0.0032	0.0060	0.4300	0.0048
22	0.0150	0.0150	0.0075	0.0060	0.0021	0.0060	0.3900	0.0028
23	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
24	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
25	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
26	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
27	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
28	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
29	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
30	0.0250	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
31	0.0250	0.0070	0.0090	0.0060	0.0021	0.0050	0.3900	0.0032
32	0.0150	0.0150	0.0075	0.0060	0.0025	0.0050	0.3900	0.0028
33	0.0250	0.0070	0.0090	0.0060	0.0021	0.0050	0.3900	0.0036
34	0.0250	0.0070	0.0090	0.0060	0.0025	0.0050	0.3900	0.0036
35	0.0150	0.0150	0.0075	0.0060	0.0025	0.0050	0.3900	0.0028
36	0.0250	0.0070	0.0090	0.0060	0.0021	0.0050	0.4300	0.0036
37	0.0250	0.0070	0.0090	0.0060	0.0025	0.0050	0.4300	0.0036
38	0.0250	0.0070	0.0090	0.0070	0.0032	0.0060	0.4300	0.0040
39	0.0250	0.0300	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
40	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
41	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028

Table 53. Continued

Crop Producing Area	Beef	Sheep	Pork	Chickens	Broilers	Turkeys	Eggs	Milk
	(Gallons per day per:)							
	(pounds of liveweight)						(1000)	(pound)
42	0.0150	0.0150	0.0075	0.0060	0.0021	0.0050	0.3900	0.0028
43	0.0150	0.0070	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
44	0.0250	0.0070	0.0105	0.0070	0.0032	0.0060	0.4300	0.0040
45	0.0250	0.0070	0.0120	0.0070	0.0032	0.0060	0.4300	0.0044
46	0.0250	0.0150	0.0135	0.0070	0.0032	0.0060	0.4300	0.0044
47	0.0350	0.0600	0.0090	0.0070	0.0032	0.0060	0.4300	0.0032
48	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
49	0.0350	0.0300	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
50	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
51	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
52	0.0350	0.0600	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
53	0.0250	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
54	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
55	0.0350	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
56	0.0350	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
57	0.0250	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
58	0.0350	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
59	0.0350	0.0300	0.0075	0.0060	0.0025	0.0050	0.3900	0.0032
60	0.0150	0.0150	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
61	0.0250	0.0070	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
62	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
63	0.0350	0.0300	0.0075	0.0070	0.0032	0.0060	0.3900	0.0032
64	0.0250	0.0150	0.0105	0.0070	0.0032	0.0060	0.3900	0.0036
65	0.0350	0.0600	0.0090	0.0070	0.0032	0.0060	0.4300	0.0036
66	0.0350	0.0600	0.0090	0.0070	0.0032	0.0060	0.4300	0.0036
67	0.0350	0.0300	0.0090	0.0070	0.0032	0.0060	0.4300	0.0036
68	0.0350	0.0300	0.0090	0.0070	0.0032	0.0060	0.4300	0.0036
69	0.0350	0.0150	0.0120	0.0070	0.0032	0.0060	0.4300	0.0040
70	0.0450	0.0150	0.0120	0.0070	0.0032	0.0060	0.4300	0.0036
71	0.0450	0.0300	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
72	0.0450	0.0060	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
73	0.0450	0.0060	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
74	0.0450	0.0060	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
75	0.0450	0.0060	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
76	0.0450	0.0060	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
77	0.0350	0.0600	0.0105	0.0060	0.0025	0.0050	0.3900	0.0032
78	0.0450	0.1200	0.0105	0.0070	0.0032	0.0060	0.4300	0.0032
79	0.0450	0.1200	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
80	0.0350	0.1200	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
81	0.0450	0.1200	0.0105	0.0070	0.0032	0.0060	0.4300	0.0036
82	0.0450	0.1200	0.0090	0.0060	0.0025	0.0050	0.3900	0.0028

Table 53. Continued

Crop Producing Area	Beef	Sheep	Pork	Chickens	Broilers	Turkeys	Eggs	Milk
	(Gallons per day per:)							
	(pounds of liveweight)						(1000)	(pound)
83	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0028
84	0.0450	0.1200	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
85	0.0550	0.1800	0.0090	0.0070	0.0032	0.0060	0.4300	0.0028
86	0.0550	0.1800	0.0090	0.0070	0.0032	0.0060	0.4300	0.0028
87	0.0550	0.1800	0.0105	0.0070	0.0032	0.0060	0.4300	0.0028
88	0.0450	0.1200	0.0105	0.0060	0.0025	0.0050	0.3900	0.0028
89	0.0550	0.1200	0.0105	0.0060	0.0025	0.0050	0.3900	0.0028
90	0.0550	0.1200	0.0105	0.0060	0.0025	0.0050	0.3900	0.0028
91	0.0450	0.0600	0.0105	0.0060	0.0025	0.0050	0.3900	0.0028
92	0.0350	0.0300	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
93	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0028
94	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0028
95	0.0350	0.0300	0.0090	0.0060	0.0025	0.0050	0.3900	0.0032
96	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
97	0.0150	0.0150	0.0090	0.0060	0.0021	0.0050	0.3900	0.0028
98	0.0350	0.0600	0.0090	0.0060	0.0025	0.0050	0.3900	0.0028
99	0.0150	0.0150	0.0105	0.0060	0.0021	0.0050	0.3900	0.0028
100	0.0250	0.0300	0.0105	0.0060	0.0025	0.0050	0.3900	0.0028
101	0.0250	0.0600	0.0105	0.0070	0.0032	0.0060	0.4300	0.0028
102	0.0150	0.0150	0.0105	0.0060	0.0021	0.0050	0.3900	0.0028
103	0.0250	0.0300	0.0105	0.0070	0.0032	0.0060	0.4300	0.0028
104	0.0450	0.1800	0.0105	0.0070	0.0032	0.0060	0.4300	0.0028
105	0.0450	0.1800	0.0105	0.0070	0.0032	0.0060	0.4300	0.0028

specified by crop producing area. Livestock production is multiplied by the weights presented in Table 54 to get over crop producing area so that livestock production in each crop producing area is calculated. These data are not used in the 1985 RCA exogenous sector, as water supplies used in the model do not include water for livestock production.

Manure Production

The last set of coefficients required for the exogenous sector are the manure coefficients. These coefficients are derived from work presented in Short and Dvoskin (1980). They estimated the coefficients for the 28 market regions used in the 1980 Resource Conservation Act analysis. An evaluation of these data indicated that assignment of the 28 region coefficients to the 31 Livestock Producing areas would suffice (Table 55). These coefficients when multiplied by exogenous production levels provide the quantities of nitrogen supplied by exogenous livestock. For further information on how these coefficients are placed into the model see English and Roel (1989).

Table 54. Livestock producing to crop producing area weights used to develop water requirements

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef	Sheep	Broiler	Eggs	Turkeys
		(Percent)						
1	1	12.71	6.24	21.48	23.74	92.49	45.24	3.28
1	2	5.01	11.49	11.97	16.39	6.8	10.78	8.17
1	3	7.73	53.62	12.67	14.55	0	6.84	81.2
1	4	13.52	7.32	13.77	10.53	0.7	29.62	1.28
1	5	21.59	16.38	23.26	26.67	0	6.88	6.08
1	6	39.44	4.96	16.85	8.12	0	0.65	0
2	7	16.66	1.99	9.06	8.24	0	2.82	0.24
2	8	0.41	1.17	1.12	2.49	0.33	0.8	0.07
2	9	14.9	21.38	16.76	15.13	16.6	21.99	0.12
2	10	40.3	67.25	58.53	43.6	83.06	62.14	98.65
2	29	27.74	8.21	14.52	30.53	0.01	12.25	0.93
3	11	26.28	18.82	33.21	27.73	64.79	19.75	0.03
3	12	53.96	7.97	36.99	69.64	11.72	19.47	96.53
3	13	19.76	73.21	29.81	2.63	23.48	60.78	3.44
4	14	34.97	42.37	29.67	4.13	43.91	39.74	99.91
4	15	30	48.72	33.12	1.26	44.07	52.33	0.01
4	37	35.03	8.91	37.21	94.61	12.03	7.93	0.08
5	16	56.78	96.82	53.38	41.65	100	94.32	77.08
5	17	43.22	3.18	46.62	58.35	0	5.68	22.92
6	28	23.92	3.06	3.52	2.72	0.04	11.01	39
6	30	14.6	2.97	11.57	9.37	0.04	6.21	18.53
6	31	19.32	16.41	28.76	16.04	0.47	27.91	21.96
6	32	35.66	75.95	38.24	56.39	54.54	53.22	3.34
6	33	6.5	1.61	17.9	15.47	44.91	1.65	17.18
7	25	53.62	45.38	45.01	34.53	62.84	44.34	0.91
7	26	17.33	6.06	21.9	6.54	0.31	11.55	0.51
7	27	29.04	48.56	33.09	58.93	36.84	44.11	98.58
8	34	51.65	19.79	49.67	20.73	60.48	6.3	0.25
8	35	30.36	70.5	28.57	74.51	15.79	82.41	99.63
8	36	17.99	9.71	21.76	4.75	23.73	11.29	0.12
9	18	19.98	34.16	22.48	3.78	20.52	25.66	8.96
9	19	21.2	20.17	30.42	3.36	37.46	28.6	33.17
9	20	21.06	11.1	21.04	16.06	22.44	23.95	24.92
9	38	37.75	34.57	26.06	76.79	19.59	21.79	32.96
10	22	3.54	0.15	2.21	0.94	0.07	2.41	0.03
10	39	80.48	87.3	57.96	57.31	99.11	87.57	7.74
10	47	15.98	12.55	39.82	41.75	0.82	10.02	92.23
11	23	34.25	18.06	16.92	10.48	0.48	20.86	37.84
11	24	8.05	14.98	11.95	12.77	0.28	22.59	41.96
11	40	57.7	66.97	71.14	76.75	99.25	56.55	20.2
12	41	95.4	78.45	76.96	76.95	95.58	70.33	99.73
12	42	4.6	21.55	23.04	23.05	4.42	29.67	0.27
13	43	45.23	54.54	29.89	82.78	0	28.87	0.1
13	44	17.37	23.1	26.06	4.74	1.34	45.87	0.06

Table 54. Continued

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef	Sheep	Broiler	Eggs	Turkeys
		(Percent)						
13	61	37.4	22.36	44.04	12.47	98.66	25.26	99.84
14	21	26.69	35.44	20.28	14.48	43.62	29.02	31.3
14	45	10.91	41.45	27.45	8.33	22.65	39.17	29.55
14	46	26.55	6.97	12.99	68.56	1.38	12.12	28.25
14	69	35.86	16.15	39.27	8.63	32.35	19.68	10.89
15	56	8.65	11.77	10.68	9.55	2.33	18.35	0.05
15	57	19.97	44.3	32.54	45.75	4.04	29.18	0.05
15	59	15.53	14.09	15.14	14.6	1.27	18.36	0
15	60	55.84	29.84	41.64	30.09	92.37	34.11	99.91
16	52	33.53	16.42	52.14	54.47	22.01	13.98	4.89
16	53	66.47	83.58	47.86	45.53	77.99	86.02	95.11
17	55	52.17	52.86	56.84	40.52	69.62	52.61	75.44
17	58	47.83	47.14	43.16	59.48	30.38	47.39	24.56
18	63	20.14	40.17	39.08	65.89	0	9.91	0.02
18	64	48.19	49.98	28.18	12.69	100	87.92	89.56
18	66	11.69	3.65	11.04	6.07	0	0.71	10.41
18	68	19.97	6.2	21.7	15.35	0	1.45	0.01
19	70	23.88	5.65	16.57	0.23	100	63.2	5.65
19	71	30.83	20.6	34.37	8.91	0	5.67	33.12
19	73	45.29	73.75	49.06	90.86	0	31.12	61.23
20	75	32.48	56.37	36.72	76.57	0	16.69	33.51
20	76	58.24	41.67	49.89	8.33	100	83.07	61.63
20	81	9.28	1.96	13.39	15.1	0	0.24	4.87
21	65	6.5	23.46	42.21	1.6	0	11.63	21.17
21	67	11.05	14.77	17.53	0.17	0	2.35	0
21	72	44.43	40.65	22.29	5.15	0	11.46	24.1
21	74	9.96	10.74	4.1	2.65	0	65.38	15.31
21	79	0	2.11	6.98	54.68	0	1.08	0
21	80	28.07	8.26	6.89	35.75	0	8.1	39.41
22	48	3.83	32.02	17.5	5.92	34.88	35.91	9.44
22	50	4.56	15.61	15.95	11.61	20.7	11.85	59.83
22	51	91.62	52.37	66.54	82.47	44.42	52.25	30.74
23	54	64.03	75.3	62.8	69.71	94.24	96.28	43.93
23	62	14.31	16.59	17.41	1.4	3.67	1.72	8.27
23	82	11.46	1.3	10.39	18.94	0	1.01	13.6
23	83	10.2	6.81	9.4	9.95	2.1	0.99	34.19
24	77	3.69	26.36	14.47	16.28	0	9.04	0
24	78	87.02	13.6	48.63	26.87	0	38.63	64.57
24	84	8.48	9.49	18.85	16.08	100	38.23	28.19
24	85	0.81	50.56	18.05	40.77	0	14.09	7.24
25	49	39.67	64.68	70.25	79.81	55.85	11.11	27.68
25	92	60.33	35.32	29.75	20.19	44.15	88.89	72.32
26	94	98.42	61.78	81.98	91.54	95.05	70.18	92.77
26	95	1.58	38.22	18.02	8.46	4.95	29.82	7.23
27	88	80.72	63.96	37.7	57.11	79	99.5	73.15

Table 54. Continued

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef	Sheep	Broiler	Eggs	Turkeys
		(Percent)						
27	89	18.85	32.2	22.37	30.97	18.45	0.12	26.85
27	90	0.44	3.84	39.92	11.92	2.55	0.38	0
28	86	9.14	20.27	21.82	35.96	0	1.41	3.83
28	87	90.86	79.73	78.18	64.04	100	98.59	96.17
29	93	13.36	37.67	59.54	27.59	0.01	8.08	0.49
29	96	38.46	50.61	23.04	70.08	79.48	34.03	99.25
29	97	48.18	11.21	5.81	1.69	20.5	57.86	0.26
29	98	0	0.5	11.61	0.64	0	0.03	0
30	91	5.52	5.92	12.04	3.96	0	0.13	0
30	99	16.81	7.32	23.18	16.82	0	0.37	0.14
30	100	30.15	59.62	48.08	41.73	14.38	22.57	86.74
30	102	47.52	27.15	16.7	37.48	85.62	76.93	13.12
31	101	60.51	68.52	47.28	61.11	95.5	36.71	49.86
31	103	1.77	13.03	22.9	2.87	0	0.8	0
31	104	37.72	18.45	28.72	34.23	4.5	62.5	50.14
31	105	0	0	1.1	1.8	0	0	0

Table 55. Nitrogen supplied through the production of livestock by type for each livestock producing area

Livestock Producing Region	Beef Cow	Beef Feeders	Dairy cows	Hogs	Sheep	Broilers	Layers
	(Pounds of Nitrogen per)						
	cow/year	feeder/year	cow/year	car. cwt.	car. cwt.	(000) lbs	(000) doz. eggs
1	52.2	0.073	85.7	2.5	1.1	19.5	30.2
2	52.2	0.084	85.7	2.5	1.1	19.5	30.2
3	16.2	0.076	75.5	1.5	1.1	19.2	27.7
4	16.2	0.076	75.5	1.5	1.1	19.2	27.7
5	16.2	0.076	75.5	1.5	1.1	19.2	27.7
6	52.2	0.081	85.7	2.6	1.1	19.9	29.8
7	52.2	0.082	85.7	2.6	1.1	20.2	29.4
8	52.2	0.081	85.7	2.6	1.1	20.2	27.7
9	16.2	0.079	75.5	1.5	1.1	19.2	29.4
10	52.2	0.079	85.7	2.6	1.1	20.2	29.4
11	52.2	0.082	85.7	2.6	1.1	20.2	29.4
12	52.2	0.081	85.7	2.6	1.1	20.2	29.4
13	52.2	0.077	79.6	2.2	1.1	19.9	28.9
14	16.2	0.075	71.4	1.8	1.1	19.5	28.3
15	52.2	0.081	83.6	2.5	1.1	17.8	26.1
16	47.8	0.079	84.7	2.6	1.1	19.0	27.7
17	47.8	0.079	83.6	2.5	1.1	19.5	28.3
18	8.0	0.074	71.4	1.8	1.1	19.5	28.3
19	0.0	0.071	71.4	1.8	1.1	19.5	28.3
20	0.0	0.071	71.4	1.8	1.1	19.5	28.3
21	0.0	0.075	71.4	1.8	1.1	19.5	27.2
22	43.3	0.079	83.6	2.5	1.1	17.8	26.1
23	37.3	0.079	83.6	2.5	1.1	17.8	26.1
24	15.7	0.079	71.4	1.7	1.1	19.5	28.3
25	43.3	0.079	83.6	2.5	1.1	17.8	26.1
26	37.3	0.079	84.7	2.3	1.1	18.5	27.8
27	31.3	0.079	83.6	2.5	1.1	17.8	26.1
28	15.0	0.079	75.8	1.9	1.1	19.4	28.1
29	31.3	0.079	85.7	2.1	1.1	20.2	29.4
30	31.3	0.079	85.7	2.1	1.1	20.2	29.4
31	31.3	0.079	71.4	1.7	1.1	19.5	28.3

Source: Adapted from (Short and Dvoskin, 1977)

CHAPTER IV. THE PARTIALLY ENDOGENOUS LIVESTOCK MODEL (PELM)

A linear programming model can be viewed as a set of equations placed in a matrix with each coefficient in that matrix representing the interaction between a production activity and the available resources. The model described in this chapter features the technologies available to produce beef, milk, and pork. These technologies incorporate numerous types of enterprises which include alternative means to deliver a final commodity. In this livestock sector, the activities produce grain-fed beef, roughage fed beef, dairy products (milk equivalents), and pork plus manure supplies to attain the prespecified production levels of these commodities, the activities require nutrients, energy, dollars, offspring, and water. In addition, this model must be linked to the crop and range sectors. Therefore, conversion of crops and pastures to nutrients is required.

Regional Delineation

So that the alternative technologies used in the various regions of the nation are reflected, this PELM is constructed using 31 Livestock Producing Areas (LPA) (See Figure 6). These LPAs are aggregations of the 105 Crop producing Areas (CPA) used in the crop sector of ARIMS.

Production activities for the various livestock commodities are limited to those livestock producing areas located in areas with significant amounts of production. The model allows those LPAs where production activities are not available, or where model production does

not meet demand, to import quantities of final livestock commodities to meet demand. Tables 56 through 59 show the final demands for milk, beef, and pork by LPA that are used for the years 1990, 2000, and 2030. For further information on these demands see English and Roel (1989).

In addition, the model allows for the transportation of feeder cattle, an intermediate livestock commodity, across LPAs as an input into the grain-fed beef production activities. Although feeder pig production and feeder pig finishing activities are available, the model does not allow for the transportation of feeder pigs between LPAs.

The Model Described

The PELM is composed of two major types of activities. These activities are designated as either "production activities" or "feed transfer activities." The production activities reflect actual production functions for producing the various types of livestock in the endogenous sector, while the feed transfer activities allow the transfer of crops produced in the crop sector of the model to meet livestock nutritional requirements.

A unique feature of the livestock model is the degree of substitution that can occur as feedstuffs fulfills the nutrient requirements of the various livestock activities. This integral part of the model thus allows the choice of the least cost ration for the livestock activities. The choice of feedstuffs is constrained by the crop production activities. However, it is possible to further constrain the selection of feedstuffs to meet any <u>apriori</u> expectations.

Table 56. Total domestic milk demands 1990, 2000, and 2030

Livestock Producing Area	Year		
	1990	2000	2030
	.....(thousand hundred-weight).....		
1	73,014	70,310	77,978
2	177,509	163,932	170,210
3	75,471	74,532	87,511
4	62,092	62,826	77,065
5	57,616	60,882	83,648
6	102,861	97,192	104,421
7	66,916	64,721	72,238
8	50,402	49,670	57,253
9	51,563	51,413	61,818
10	27,333	27,308	32,525
11	71,364	68,656	75,113
12	35,232	34,012	37,637
13	32,651	31,816	36,125
14	44,387	44,508	53,565
15	28,315	27,320	30,892
16	6,389	6,193	7,104
17	3,895	3,770	4,318
18	31,900	31,723	37,704
19	53,968	56,847	70,842
20	21,787	22,829	28,280
21	7,930	8,061	9,716
22	2,781	2,818	3,485
23	21,515	22,971	29,809
24	10,590	10,846	13,212
25	5,817	5,823	7,045
26	6,070	6,303	7,622
27	9,127	9,719	12,370
28	19,699	21,163	28,380
29	39,326	40,672	51,009
30	46,353	47,440	58,080
31	100,771	102,053	122,871
Total	1,344,644	1,328,329	1,549,846

Source: English and Roel, 1989.

Table 57. Total domestic grain-fed beef demands 1990, 2000, and 2030

Livestock Producing Area	Year		
	1990	2000	2030
	.....(thousand hundred-weight).....		
1	18,897	19,522	21,621
2	45,941	45,516	47,193
3	19,533	20,694	24,264
4	16,070	17,444	21,367
5	14,912	16,904	23,193
6	26,622	26,985	28,952
7	17,319	17,970	20,029
8	13,045	13,791	15,874
9	13,345	14,275	17,140
10	7,074	7,582	9,018
11	18,470	19,062	20,826
12	9,118	9,443	10,435
13	8,451	8,834	10,016
14	11,488	12,358	14,852
15	7,328	7,585	8,565
16	1,653	1,719	1,970
17	1,008	1,047	1,197
18	8,256	8,808	10,454
19	13,968	15,784	19,642
20	5,639	6,339	7,841
21	2,052	2,238	2,694
22	720	782	966
23	5,568	6,378	8,265
24	2,741	3,011	3,663
25	1,506	1,617	1,953
26	1,571	1,750	2,113
27	2,362	2,698	3,430
28	5,098	5,876	7,869
29	10,178	11,293	14,143
30	11,997	13,172	16,104
31	26,081	28,335	34,068
Total	348,011	368,812	429,717

Source: English and Roel, 1989.

Table 58. Total domestic roughage-fed beef demands 1990, 2000, and 2030

Livestock Producing Area	Year		
	1990	2000	2030
	.....(thousand hundred-weight).....		
1	4,724	4,880	5,405
2	11,485	11,379	11,798
3	4,883	5,174	6,066
4	4,017	4,361	5,342
5	3,728	4,226	5,798
6	6,655	6,746	7,238
7	4,330	4,492	5,007
8	3,261	3,448	3,969
9	3,336	3,569	4,285
10	1,769	1,896	2,254
11	4,617	4,766	5,207
12	2,280	2,361	2,609
13	2,113	2,208	2,504
14	2,872	3,089	3,713
15	1,832	1,896	2,141
16	413	430	492
17	252	262	299
18	2,064	2,202	2,614
19	3,492	3,946	4,911
20	1,410	1,585	1,960
21	513	560	673
22	180	196	242
23	1,392	1,594	2,066
24	685	753	916
25	376	404	488
26	393	438	528
27	591	675	857
28	1,275	1,469	1,967
29	2,545	2,823	3,536
30	2,999	3,293	4,026
31	6,520	7,084	8,517
Total	87,002	92,205	107,428

Source: English and Roel, 1989

Table 59. Total domestic pork demands 1990, 2000, and 2030

Livestock Producing Area	Year		
	1990	2000	2030
	.....(thousand hundred-weight).....		
1	12,543	12,398	13,194
2	30,495	28,906	28,799
3	12,965	13,142	14,807
4	10,667	11,078	13,039
5	9,898	10,736	14,153
6	17,671	17,138	17,668
7	11,496	11,412	12,223
8	8,659	8,758	9,687
9	8,858	9,066	10,460
10	4,696	4,815	5,503
11	12,260	12,106	12,709
12	6,053	5,997	6,368
13	5,609	5,610	6,112
14	7,625	7,848	9,063
15	4,864	4,817	5,227
16	1,098	1,092	1,202
17	669	665	731
18	5,480	5,594	6,380
19	9,271	10,024	11,986
20	3,743	4,026	4,785
21	1,362	1,421	1,644
22	478	497	590
23	3,696	4,051	5,044
24	1,819	1,912	2,236
25	999	1,027	1,192
26	1,043	1,111	1,290
27	1,568	1,714	2,093
28	3,384	3,732	4,802
29	6,756	7,172	8,631
30	7,963	8,365	9,827
31	17,312	17,995	20,790
Total	231,000	234,225	262,235

Source: English and Roel, 1989.

In the pages that follow, a description of the production activities and coefficients are summarized. Then, there is a brief description of the feed transfer activities. Finally, a schematic of a partial matrix illustrating a livestock production area is presented. Much of the detailed data are shown in a set of appendices that provide examples of actual data used and how coefficients used in the activities are calculated. If more detailed information on the methodology behind a particular set of coefficients is desired, consult either Schraufnagel and English (1982) or Disney and English (1984).

Production Activities

There are six basic types of endogenous livestock production activities which require various inputs from the model and provide byproduct inputs and final and intermediate outputs to the model (Figure 16). Livestock production activities are defined regionally and produce a commodity and nitrogen via manure while requiring feed and capital (Table 60).

Dairy activities produce milk as a primary product and also steer calves and roughage-fed beef as intermediate outputs, and joint-product final outputs, respectively. The activity is defined on the basis of 100 pounds of milk produced.

Pork production has three distinct activities defined for it. Farrow-to-finish activities produce pork as the primary product and include the management of a breeding herd. Feeder pig production activities produce feeder pigs as the primary output. Since this

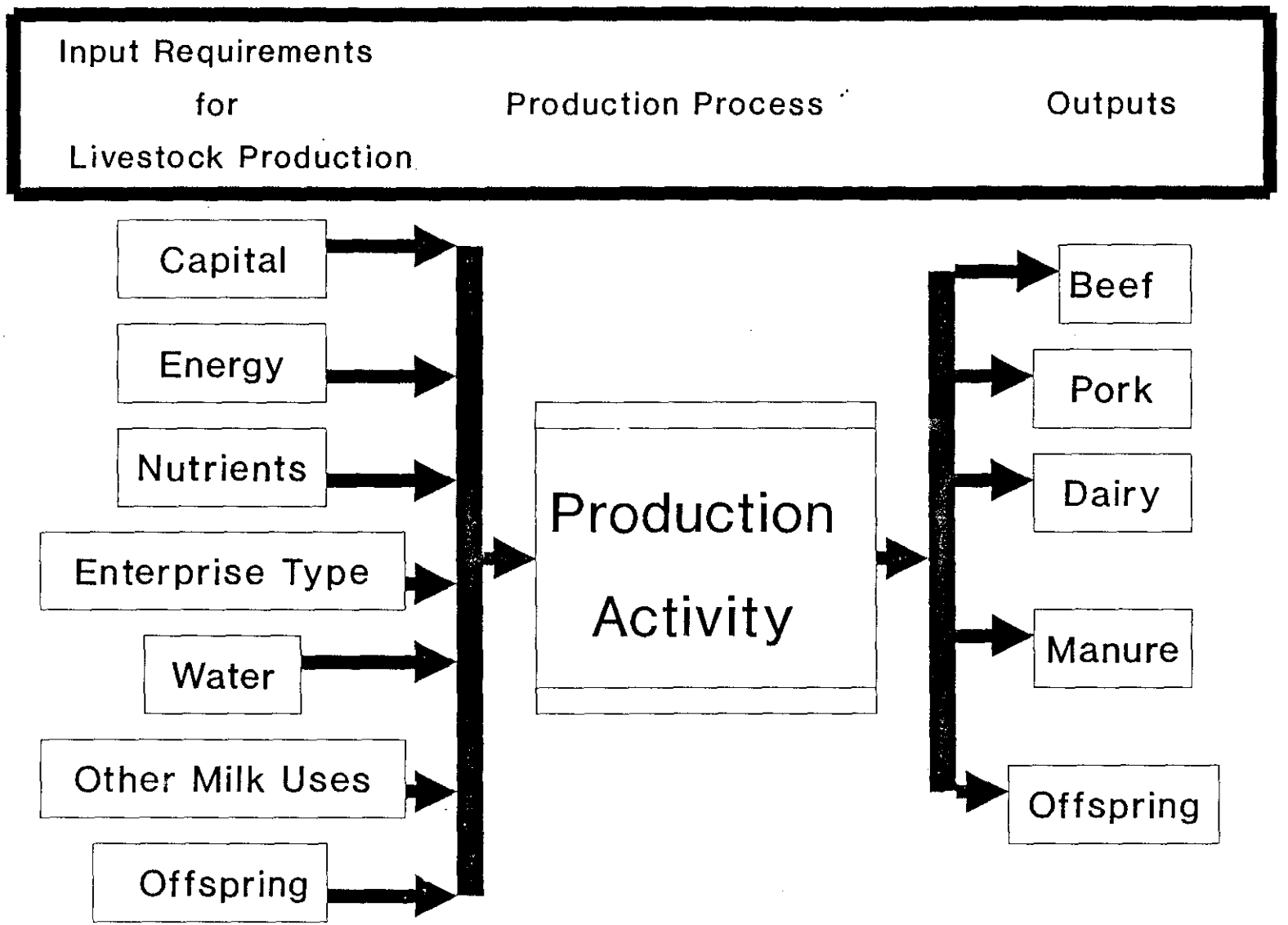

Figure 16. Input requirements and outputs of the endogenous livestock sector

Table 60. Description of the endogenous livestock activity reflecting requirements and supplies

Livestock Activity Type	Requirements from the Model[a]				Provides to the Model						
	Capital	Feed	Feeder Cattle	Feeder Pigs	Nitrogen	Feeder Cattle	Feeder Pigs	Grain-fed Beef	Rougage-fed Beef	Pork	Milk
Dairy	X	X			X	X			X		X
Feeder cattle finish-grain	X	X	X		X			X			
Feeder cattle finish-roughage	X	X	X		X				X		
Feeder cattle production	X	X			X	X			X		
Farrow-to-finish	X	X			X						
Feeder pig production	X	X			X		X			X	
Feeder pig finishing	X	X		X	X					X	

[a]Note all livestock activities require feed and water from the model.

activity also requires the management of a breeding herd, the culls from this herd provide a joint-product output of pork. The final activity available for pork production is the feeder pig finishing activity. The major objective of this activity is the production of pork. If feeder pig finishing activities come into solution in a particular region, then feeder pig production activities also come into solution because 1) feeder pig finishing activities require feeder pigs as an input and 2) feeder pigs are not transported between the livestock producing areas in this model.

The final livestock commodity produced in the model is beef, with beef produced through either grain-fed and/or roughage-fed finishing activities. These final activities both require feeder cattle. Grain-fed beef is finished with a ration constraint of between 10 percent and 50 percent of its dry matter content in roughages. Roughage-fed beef, on the other hand, is finished with a ration consisting of no more than 90 percent of its dry matter content to be roughage in the form of hay and pasture. Feeder cattle production activities supply the finishing activities with calves, calves and yearlings, or yearlings. These activities also produce roughage-fed beef through breeding herd culling.

Budgets behind activities: All pork and beef production activities are based upon budget data contained in the Firm Enterprise Data System's livestock budgets developed by the U.S. Department of

Agriculture (Economic Research Service, 1981). These budgets are based on data collected by the Economic Research Service through national farm surveys between 1978 and 1979 and reflect average management, practices, and performance. It should be noted that costs of production, presented in these budgets, do not reflect actual costs for any given livestock producing unit, but average costs of production for similar sized production units in that specific area in 1979. The budget number and a description of the budgets along with an estimate or production is provided in Table 61. Complete geographical coverage of the various livestock types is not included in the model. Table 62 provides coverage information. If production of a commodity is not present in a given area, the area must transport livestock commodities into their region in order to meet their final demands.

Alternative technologies: An important feature of this livestock sector is the incorporation of activities representing different sizes. For pork production, farrow-to-finish activities are built from budgets ranging in size from 40 to 5,000 head; feeder pig production activities are built from budgets ranging in size from 140 to 1,600 head; and finally, feeder pig finishing activities are built from budgets ranging in size from 140 to 5,000 head. Grain-fed beef finishing activities are built from budgets ranging in size from 35 up to 51,000 head. Feeder budgets ranging in size from 140 to 5,000 head. Grain-fed beef

Table 61. Budget identification information for the endogenous livestock sector

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Cow/yearling Herds < 100 head	CP-1	51	188.52
Cow/yearling Herds > 100 head	CP-1	52	379.22
Cow/yearling Herds < 200 head	CP-2	53	746.49
Cow/yearling Herds > 200-500 head	CP-2	56	624.77
Cow/yearling Herds > 500 head	CP-2	57	1744.69
Cow/yearling Herds < 100 head	CP-3	59	147.29
Cow/yearling Herds > 100-199 head	CP-3	60	346.42
Cow/yearling Herds > 200 head	CP-3	61	1250.23
Cow/yearling Herds 100 - 199 head	CP-4	64	338.56
Cow/yearling Herds > 200 head	CP-4	65	1056.77
Cow/yearling Herds < 100 head	CP-5	67	199.4
Cow/yearling Herds > 100-199 head	CP-5	68	329.72
Cow/yearling Herds > 200 head	CP-5	76	145.9
Cow/Calf/Yearling, 150 Cows	W-1	77	724.01
Cow/Calf/Yearling, 300 Cows	W-1	78	1068.74
Cow/Calf/Yearling, 50 Cows	W-2	79	169.66
Cow/Calf/Yearling, 150 Cows	W-2	80	445.18
Cow/Calf/Yearling, 300 Cows	W-2	81	909.67
Cow/Calf/Yearling, 700 Cows	W-2	82	2488.1
Cow/Calf/Yearling, 1500 Cows	W-2	83	3435.05
Cow/Calf/Yearling, 150 Cows	W-3	85	523.33
Cow/Calf/Yearling, 700 Cows	W-4	89	2119.34
Cow/Calf/Yearling, 1500 Cows	W-4	90	3814.61
Cow/Calf/Yearling, 150 Cows	W-5	91	521.04
Cow/Calf/Yearling, 300 Cows	W-5	92	847.18
Cow/Calf/Yearling, 700 Cows	W-5	93	2202.96
Cow/Calf/Yearling, 50 Cows	W-6	94	100.28
Cow/Calf/Yearling, 150 Cows	W-6	95	438.14
Cow/Calf/Yearling, 300 Cows	W-6	96	952.31
Beef Cow/Calf, 100 - 199 Cows	SE-1	102	385.6
Beef Cow/Calf, > 200 Cows	SE-1	103	800.8
Beef Cow/Calf, < 100 Cows	SE-2	104	143.95
Beef Cow/Calf, 100 - 199 Cows	SE-2	105	394.49
Beef Cow/Calf, > 200 Cows	SE-2	106	817.7
Beef Cow/Calf, < 100 Cows	SE-3	107	156.15
Beef Cow/Calf, < 100 Cows	SE-4	110	183.3
Beef Cow/Calf, < 100 Cows	SE-5	113	147.6
Beef Cow/Calf, 100 - 199 Cows	SE-5	114	485.4
Beef Cow/Calf, 200-499 Cows	SE-5	115	867.9
Beef Cow/Calf, > 500 Cows	SE-5	116	2450.4
Beef Cow/Calf, < 100 Cows	SE-6	117	125.9
Beef Cow/Calf, 200-499 Cows	SE-6	119	851
Beef Cow/Calf, > 500 Cows	SE-6	120	4824.25

Table 61. Continued

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Beef Cow/Calf, < 100 Cows	SE-7	121	134.1
Beef Cow/Calf, < 100 Cows	SE-8	124	102.4
Beef Cow/Calf, 100 - 199 Cows	SE-8	125	350.6
Beef Cow/Calf, < 100 Cows	SE-9	127	105.8
Beef Cow/Calf, 100 - 199 Cows	SE-9	128	393.8
Beef Cow/Calf, > 200 Cows	SE-9	129	688.5
Beef Cow/Calf, < 100 Cows	SE-10	130	111.2
Beef Cow/Calf, 100 - 499 Cows	SE-10	131	700.7
Beef Cow/Calf, > 500 Cows	SE-10	132	1808.7
Cow/yearling Herds < 100 head	NC-1	133	151.5
Cow/yearling Herds > 100 head	NC-1	134	460.1
Cow/yearling Herds < 100 head	NC-2	136	186.6
Cow/yearling Herds > 100 head	NC-2	137	538.9
Beef Cow/Calf, < 100 Cows	NC-3	139	162.9
Beef Cow/Calf, 100 - 199 Cows	NC-3	140	437.6
Beef Cow/Calf, > 200 Cows	NC-3	141	944.7
Beef Cow/Calf, < 100 Cows	NC-4	142	141.9
Beef Cow/Calf/Yearling 200-499 Cows	SW-1	252	783.9
Beef Cow/Calf/Yearling 500-999 Cows	SW-1	253	2199.1
Beef Cow/Calf 200-499 Cows	SW-2	254	749.4
Beef Cow/Calf/Yearling 500-999 Cows	SW-2	255	2218.3
Beef Cow/Calf/Yearling > 1000 Cows	SW-2	256	5199.7
Beef Cow/Calf/Yearling 100-199 Cows	SW-3	257	450.2
Beef Cow/Calf 200-499 Cows	SW-3	258	784.8
Beef Cow/Calf > 1000 Cows	SW-3	259	4248.3
Beef Cow/Calf/Yearling 100-199 Cows	SW-4	260	427
Beef Cow/Calf/Yearling 200-499 Cows	SW-4	261	1032.8
Beef Cow/Calf > 1000 Cows	SW-4	262	3983.9
Beef Cow/Calf/Yearling < 100 Cows	SW-5	263	163
Beef Cow/Calf/Yearling 200-499 Cows	SW-5	265	1197.9
Beef Cow/Calf < 100 Cows	SW-6	266	132.1
Beef Cow/Calf 200-499 Cows	SW-6	268	918.9
Beef Cow/Calf 100-199 Cows	SW-7	269	397
Beef Cow/Calf 200-499 Cows	SW-7	270	898.4
Beef Cow/Yearling > 1000 Cows	SW-7	271	5979.4
Beef Cow/Calf < 100 Cows	SW-8	272	132.8
Beef Cow/Calf/Yearling 100-199 Cows	SW-8	273	425.4
Beef Cow/Calf 500-999 Cows	SW-8	274	1826.5
Beef Cow/Calf < 100 Cows	SW-9	275	141.4
Beef Cow/Calf 100-199 Cows	SW-9	276	365.7
Beef Cow/Calf 200-499 Cows	SW-9	277	693
Beef Cow/Calf 100-199 Cows	SW-10	278	418
Beef Cow/Calf 200-499 Cows	SW-10	279	730

Table 61. Continued

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Beef Cow/Calf 500-999 Cows	SW-10	280	1872.9
Beef Cow/Calf < 100 Cows	SW-11	281	114.2
Beef Cow/Calf/Yearling 200-499 Cows	SW-11	283	769.6
Dairy - New England		301	14312.5
Dairy - California		302	78937.3
Dairy - Georgia		303	22570.9
Dairy - Illinois		304	8026.5
Dairy - Indiana		305	8056.3
Dairy - Iowa		306	8080.4
Dairy - Kentucky		307	8267
Dairy - Michigan		308	10884.3
Dairy - Minnesota		309	6828
Dairy - Missouri		310	7495.5
Dairy - New York		311	10585.4
Dairy - North Carolina		312	17757.4
Dairy - Ohio		313	8052.6
Dairy - Pennsylvania		314	8863.4
Dairy - South Dakota		315	7790.9
Dairy - Tennessee		316	9761.3
Dairy - Texas		317	24576.4
Dairy - Virginia		318	15193.7
Dairy - Washington		319	31802.4
Dairy - Wisconsin		320	8154.6
Farrow-to-Finish Hogs 300 Head	SCLS	491	702.6
Farrow-to-Finish Hogs 600 Head	SCLS	492	1525.9
Farrow-to-Finish Hogs 40 Head	SCB	493	96.5
Farrow-to-Finish Hogs 140 Head	SCB	494	335.2
Farrow-to-Finish Hogs 300 Head	SCB	495	702.6
Farrow-to-Finish Hogs 650 Head	SCB	496	1525.9
Farrow-to-Finish Hogs 1600 Head	SCB	497	3734.4
Farrow-to-Finish Hogs 40 Head	ECB	498	96.5
Farrow-to-Finish Hogs 140 Head	ECB	499	335.2
Farrow-to-Finish Hogs 300 Head	ECB	500	702.6
Farrow-to-Finish Hogs 650 Head	ECB	501	1525.9
Farrow-to-Finish Hogs 1600 Head	ECB	502	3734.4
Farrow-to-Finish Hogs 5000 Head	ECB	503	11775.1
Farrow-to-Finish Hogs 40 Head	WCB	504	96.5
Farrow-to-Finish Hogs 140 Head	WCB	505	335.2
Farrow-to-Finish Hogs 300 Head	WCB	506	702.6
Farrow-to-Finish Hogs 300 Head	WCB	507	702.6
Farrow-to-Finish Hogs 650 Head	WCB	508	1525.9
Farrow-to-Finish Hogs 1600 Head	WCB	509	3734.4
Farrow-to-Finish Hogs 5000 Head	WCB	510	11775.1

Table 61. Continued

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Farrow-to-Finish Hogs 40 Head	ESE	511	90.1
Farrow-to-Finish Hogs 140 Head	ESE	512	311.9
Farrow-to-Finish Hogs 300 Head	ESE	513	665.7
Farrow-to-Finish Hogs 650 Head	ESE	514	1439.8
Farrow-to-Finish Hogs 1600 Head	ESE	515	3542.1
Farrow-to-Finish Hogs 5000 Head	ESE	516	11180.9
Farrow-to-Finish Hogs 40 Head	WSE	517	90.1
Farrow-to-Finish Hogs 140 Head	WSE	518	311.9
Farrow-to-Finish Hogs 300 Head	WSE	519	665.7
Farrow-to-Finish Hogs 650 Head	WSE	520	1439.8
Farrow-to-Finish Hogs 1600 Head	WSE	521	3542.1
Farrow-to-Finish Hogs 300 Head	SW	522	704.7
Farrow-to-Finish Hogs 650 Head	SW	523	1506.4
Farrow-to-Finish Hogs 1600 Head	SW	524	3692.5
Feeder Pig Finishing 650 Head	SCLS	525	1508
Feeder Pig Finishing 300 Head	SWCB	526	696
Feeder Pig Finishing 650 Head	SWCB	527	1508
Feeder Pig Finishing 140 Head	NECB	528	324.8
Feeder Pig Finishing 300 Head	NECB	529	696
Feeder Pig Finishing 650 Head	NECB	530	1508
Feeder Pig Finishing 1600 Head	NECB	531	3712
Feeder Pig Finishing 140 Head	NWCB	532	324.8
Feeder Pig Finishing 300 Head	NWCB	533	696
Feeder Pig Finishing 650 Head	NWCB	534	1508
Feeder Pig Finishing 1600 Head	NWCB	535	3712
Feeder Pig Finishing 5000 Head	NWCB	536	11600
Feeder Pig Finishing 300 Head	ESE	537	666
Feeder Pig Finishing 650 Head	ESE	538	1443
Feeder Pig Finishing 1600 Head	ESE	539	3552
Feeder Pig Finishing 300 Head	WSE	540	666
Feeder Pig Finishing 1600 Head	WSE	541	3632
Feeder Pig Production 300 head	SCLS	544	130.9
Feeder Pig Production 650 head	SCLS	545	283.9
Feeder Pig Production 650 head	NECB	546	283.9
Feeder Pig Production 140 head	WCB	547	60.3
Feeder Pig Production 300 head	WCB	548	130.9
Feeder Pig Production 650 head	WCB	549	283.95
Feeder Pig Production 1600 head	WCB	550	702.45
Feeder Pig Production 300 head	SWCB	551	130.95
Feeder Pig Production 650 head	SWCB	552	283.95
Feeder Pig Production 140 head	SE	553	74.25
Feeder Pig Production 300 head	SE	554	160.05
Feeder Pig Production 650 head	SE	555	347.05

Table 61. Continued

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Feeder Pig Production 1600 head	SE	556	858.55
Feeder Pig Production 1600 head	SW	557	905.38
Finish 35 steer calves no silage	NC	561	368
Finish 35 steer calves with silage	NC	562	368
Finish 35 yearling steers no silage	NC	563	385
Finish 35 heifer calves no silage	NC	564	324
Finish 35 heifer calves with silage	NC	565	324
Finish 35 yearling heifers no silage	NC	566	333
Finish 140 steer calves with silage	NC	567	1470
Finish 140 yearling steers with silage	NC	568	1540
Finish 140 heifer calves with silage	NC	569	1295
Finish 140 yearling heifers with silage	NC	570	1330
Finish 350 steer calves with dry corn	NC	571	3675
Finish 350 steer calves with wet corn	NC	572	3675
Finish 350 yearling steers with wet corn	NC	574	3850
Finish 350 heifer calves with dry corn	NC	575	3238
Finish 350 heifer calves with wet corn	NC	576	3238
Finish 350 yearling heifers with dry corn	NC	577	3325
Finish 350 yearling heifers with wet corn	NC	578	3325
Finish 700 steer calves with wet corn	NC	579	7350
Finish 700 yearling steers with wet corn	NC	580	7700
Cattle feeding Commercial feedlot 6553 head/mixed	CP	582	70613
Cattle feeding Commercial feedlot 23984 head/mixed	CP	583	254626
Cattle feeding Commercial feedlot 51907 head/mixed	CP	584	551070
Cattle feeding Commercial feedlot 15379 head/mixed	SP	585	152937
Cattle feeding Commercial feedlot 49841 head/mixed	SP	586	498889
Cattle feeding Commercial feedlot 12359 head/mixed	SW	587	126152
Cattle feeding Commercial feedlot 36095 head/mixed	SW	588	368342
Roughage fed beef finishing 241 steers/1050 lbs		600	2531
Roughage fed beef finishing 88 steers/1050 lbs		601	924
Roughage fed beef finishing 241 heifers/925 lbs		602	2229
Roughage fed beef finishing 88 heifers/925 lbs		603	814
Roughage fed beef finishing 243 steers/1050 lbs		604	2552
Roughage fed beef finishing 88 steers/1050 lbs		605	924
Roughage fed beef finishing 243 heifers/925 lbs		606	2248
Roughage fed beef finishing 88 heifers/925 lbs		607	814
Roughage fed beef finishing 1148 mixed/1050 & 925lbs		608	11337
Roughage fed beef finishing 82 steers/1050 lbs		609	861
Roughage fed beef finishing 82 heifers/925 lbs		610	759
Roughage fed beef finishing 89 steers/1050 lbs		611	935
Roughage fed beef finishing 84 steers/1050 lbs		612	882
Roughage fed beef finishing 272 steers/1050 lbs		613	2856
Roughage fed beef finishing 487 steers/1050 lbs		614	5114

Table 61. Continued

Budget Name	Location[a]	Budget File Number	Production Unit Divisor[b]
Roughage fed beef finishing 89 heifers/925 lbs		615	823
Roughage fed beef finishing 84 heifers/925 lbs		616	777
Roughage fed beef finishing 272 heifers/925 lbs		617	2516
Roughage fed beef finishing 487 heifers/925 lbs		618	4505
Roughage fed beef finishing 257 steers/1050 lbs		619	2699
Roughage fed beef finishing 257 heifers/925 lbs		620	2377
Roughage fed beef finishing 78 steers/1050 lbs		621	819
Roughage fed beef finishing 83 steers/1050 lbs		622	872
Roughage fed beef finishing 1179 mixed/1050 & 925lbs		623	11643
Roughage fed beef finishing 233 steers/1050 lbs		624	2447
Roughage fed beef finishing 468 steers/1050 lbs		625	4914
Roughage fed beef finishing 78 heifers/925 lbs		626	722
Roughage fed beef finishing 83 heifers/925 lbs		627	768
Roughage fed beef finishing 233 heifers/925 lbs		628	2155
Roughage fed beef finishing 468 heifers/925 lbs		629	4329
Roughage fed beef finishing 224 steers/1050 lbs		630	2352
Roughage fed beef finishing 224 heifers/925 lbs		631	2072
Roughage fed beef finishing 86 steers/1050 lbs		632	903
Roughage fed beef finishing 438 steers/1050 lbs		633	4599
Roughage fed beef finishing 252 steers/1050 lbs		634	2646
Roughage fed beef finishing 86 heifers/925 lbs		635	796
Roughage fed beef finishing 438 heifers/925 lbs		636	4052
Roughage fed beef finishing 252 heifers/925 lbs		637	2331
Roughage fed beef finishing 2672 mixed/1050 & 925lbs		638	26386
Roughage fed beef finishing 491 steers/1050 lbs		639	5156
Roughage fed beef finishing 2585 mixed/1050 & 925lbs		640	25528
Roughage fed beef finishing 491 heifers/925 lbs		641	4542
Roughage fed beef finishing 532 steers/1050 lbs		642	5586
Roughage fed beef finishing 532 heifers/925 lbs		643	4921

[a]
CP=Central Plains
ECB= Eastern Corn Belt
ESE= East Southeast
NC=North Central
NECB=Northeast Corn Belt
NWCB=Northwest Corn Belt
SCLS=South Central Lake States
SCB=Southern Corn Belt
SE=Southeast
SP=Southern Plains
SW=Southwest
SWCB=Southwest Corn Belt
WCB=Western Corn Belt
WSE=West Southeast
W=West

[b] Expressed in hundredweight of final primary product

Table 62. Number of activities in each Livestock Producing Area by major livestock category

Livestock Producing Center	Transport Center	Dairy	Pork	Feeder Cattle	Grain-fed Beef	Roughage-fed Beef
		------ number of production activities ------				
1	Boston	2	--	--	--	--
2	New York	2	--	--	--	--
3	Norfolk	2	13	6	--	4
4	Charleston	3	18	6	--	8
5	Miami	1	13	6	--	5
6	Columbus	7	11	1	15	--
7	Detroit	3	14	3	15	--
8	Louisville	4	18	9	15	8
9	Montgomery	2	18	12	--	10
10	Duluth	2	17	4	15	2
11	Milwaukee	1	20	3	15	2
12	Davenport	4	23	2	15	2
13	Cape Giraudeau	3	24	9	15	6
14	New Orleans	--	10	10	2	11
15	St. Joseph	2	21	4	18	--
16	Pierre	1	17	9	15	2
17	North Platte	--	21	4	28	11
18	Oklahoma City	2	21	8	20	9
19	Houston	1	16	13	2	10
20	San Antonio	1	15	12	2	5
21	Clovis	1	15	8	2	4
22	Billings	--	--	8	--	--
23	Denver	--	--	7	5	--
24	Albuquerque	1	5	8	7	5
25	Missoula	--	--	8	--	--
26	Boise	--	--	11	--	--
27	Elko	--	--	5	5	--
28	Phoenix	--	5	7	5	3
29	Portland	1	--	11	--	--
30	San Francisco	1	--	13	5	--
31	Los Angeles	1	--	8	5	2
TOTALS		48	335	214	216	98

finishing activities are built from budgets ranging in size from 35 up to 51,000 head while roughage-fed beef finishing activities are built from budgets ranging in size from 84 up to 1,500 head. For feeder cattle production, activities are built from budgets ranging in size from 45 to 1,500 head. Finally, diary activities are built from budgets ranging in size from 53 up to 533 milk cows.

For each livestock type the complete activity size range is not necessarily present in each market region. The size range for any given livestock producing area depends on the predominant technologies that occur.

Unit of production: All livestock production activities are designed to produce 100 pounds of the primary output.[8] Thus, a dairy activity produces 100 pounds of milk, a feeder cattle production activity produces 100 pounds of feeder cattle, a feeder cattle finishing activity produces 100 pounds of beef, a farrow-to-finish and a feeder pig finishing activity each produce 100 pounds of pork, while a feeder pig production activity produces 100 pounds of feeder pigs. All technical coefficients and the objective function for each livestock activity are defined in terms of 100 pounds of primary output. Table 63 shows the livestock production activity types and the units of production that are utilized in the model.

To represent technological advances, when solving the model for future time periods, the final output yields are increased. These increases are achieved by multiplying the 100 pounds of primary output

Table 63. Endogenous activities with outputs defined

Activity Code	Activity Type	Definition	Units of Primary Product (cwt)
A10	Dairy		Milk
A21	Pork	Farrow-to-finish	Pork liveweight
A22	Pork	Feeder pig finish	Pork liveweight
A23	Pork	Feeder pig production	Feeder pigs liveweight
A31	Feeder beef	Cow-calf	Feeder beef liveweight
A32	Feeder beef	Cow-calf yearling	Feeder beef liveweight
A33	Feeder beef	Cow-yearling	Feeder beef liveweight
A41	Finished beef	Grain-fed heifer calves	Beef liveweight
A42	Finished beef	Grain-fed steer calves	Beef liveweight
A43	Finished beef	Grain-fed heifer yearlings	Beef liveweight
A44	Finished beef	Grain-fed heifers and steers	Beef liveweight
A45	Finished beef	Grain-fed steer yearlings	Beef liveweight
A51	Finished beef	Roughage-fed heifers	Beef liveweight
A52	Finished beef	Roughage-fed steers	Beef liveweight

Table 64. Livestock output technology levels on a breeding female basis in the livestock model by animal type, 1990, 2000, and 2030

Animal Types	Year		
	1990[a]	2000	2030
	percent of increase		
Beef	11	25	60
Pork	16	35	60
Dairy	13	30	65

[a]Straight line estimate between 1982 and 2000.

Source: English, Maezold, Holding, and Heady, 1984.

times the level of technology (Table 64). It is estimated that beef will increase by 25 percent per breeding female by 2000 and 60 percent by 2030. Pork and dairy show similar increases.

Feeding mechanism: The feeding mechanism has a rather unique design with nutrient requirements calculated from the National Research Council recommendations for the production of the primary product and the maintenance of any breeding stock, young and replacement stock (National Academy of Sciences, 1976, 1978, 1979).

For dairy, the nutrient requirements are defined in terms of net energy, crude protein, calcium and phosphorous (National Academy of Sciences, 1978). Feeder cattle finishing and feeder cattle production activities also have nutrient requirements defined in similar terms above (National Academy of Sciences, 1976). All pork activities have nutrient requirements defined in terms of metabolizable energy, crude protein, calcium, phosphorous and lysine (National Academy of Sciences, 1979). Examples of the calculations of feed requirements are shown in Tables A.1 to A.3 of Appendix A.

The upper and lower roughage constraints are constructed based on information provided in Schraufnagel and English (1982). These roughage restrictions constrain the dry matter content of the ration so that the biological needs of ruminants are met (primary reason for lower constraint), and so that the assumed production levels can be achieved (primary purpose for upper constraint). The levels of constraints are shown in Table 65 with the assumed levels of dry matter presented in

Table 66. The maximum roughage restriction is then effectively implemented using the following steps:

1. Let g = grain, r = roughage and MAXC as the value of the maximum roughage constraint,
2. such that; $\frac{g}{r+g} < MAXC$
3. combining terms; $g < MAXc * (r+g)$
4. rewriting; $g - (MAXC * r) - (MAXC * g) < 0$
5. and finally; $g * (1-MAXC) - MAXC * r < 0$

The minimum roughage restriction is similarly implemented as follows;

1. Let g = grain, r = roughage, and leg MINC be the value of the maximum roughage constraints,
2. such that; $\frac{g}{r+g} > MINC$
3. combining terms; $g > MINC * (r+g)$
4. rewriting; $g - (MINC * r) - (MINC * g) > 0$
5. and finally; $g * (1 - MINC) - r * MINC > 0$

Additionally, changes in feeding efficiency are built into the model over time to reflect increased efficiency in the conversion rate. Tables 67 and 68 show the assumed increases for the endogenous livestock types over the next 50 years.

Cost calculation: All livestock production costs are derived from the Firm Enterprise Data System (Economic Research Service, 1981). The objective function value includes all pertinent costs of production other than those accounted for endogenously, such as the costs of feed and water. There are four major cost categories:

Table 65. Roughage consumption restrictions

Livestock Category	Restriction Type	
	Maximum	Minimum
Dairy	60	35
Feeder cattle production	NC[a]	35
Feeder cattle finishing, grain-fed	50	10
Feeder cattle finishing, roughage-fedn	NC	90

[a]NC indicates no constraint.

Table 66. Dry matter content by crop

Crop	Dry Matter (pounds)	Crop	Dry Matter (pounds)
Barley	42.72	Sorghum	49.28
Corn	49.84	Sorghum silage[b]	290.00
Corn silage[b]	350.00	Soybeans	53.40
Legume hay[b]	1,720.00	Wheat	53.40
Nonlegume hay[b]	1,720.00	Private pasture[b]	560.00
Oats	28.48	Public pasture[b]	560.00

[a]Grains assume 12.35 percent moisture.

[b]Roughage crops.

Table 67. Feed conversion efficiency increase assumptions for nutrient and energy requirements other than protein

Endogenous Livestock Category	Feed Conversion Efficiency Increases		
	To 1990	1990 to 2000	2000 to 2030
	percentages		
Beef	10.5	5	5
Milk	5.3	5	5
Pork	10.5	5	5

[a]Assumptions based on verbal suggestion of animal scientists (Brackelsberg, 1981) at Iowa State University and comparison of past and present occurrences.

Table 68. Protein conversion efficiencies, 1990, 2000, and 2030

Endogenous Livestock Category	Year of Analysis		
	To 1990[a]	1990 to 2000	2000 to 2030
	percentages		
Beef	7	15	5
Pork	5	12	25
Dairy	3	10	20

[a]Straight line estimate between 1982 and 2000.

Source: English, Maetzold, Holding, and Heady, 1984.

1) Labor;

2) Machinery and equipment;

3) Transportation and marketing; and

4) Miscellaneous

Table 69 lists the costs included in the objective function of various activities by category. It should be noted that each of the cost items listed does not appear in every activity. For example, smaller farms would not employ yard crews or consultants. Table 70 shows the aggregated costs for selected representative livestock budgets.

Other coefficients: Two other types of coefficients are found in the activities representing all of the livestock types. These coefficients represent the water requirements of each activity and the nitrogen supplied by each activity in the form of manure.

The water coefficients are determined from data supplied by the Agricultural Resource Assessment System technical committee (1975) and presented in English, Alt, and Heady (1982). Table B.1 of Appendix B shows the water use conversion factors that were used in developing the coefficients for livestock water use in the production activities. When differences between crop producing areas within each livestock producing area are present, a weighting scheme based on historical production weights[9] within each LPA is used to find a water-use conversion factor

Table 69. List of livestock cost items incorporated into each major category

Major Category	Cost Item
Labor	Hired labor
	Family
	Equipment labor
	Livestock labor
	Yard crew
	Managers
	Accountants
	Consultants
	Mechanic
	Truck drivers
Machinery and equipment	Machinery fuel and lube
	Machinery repair
	Equipment fuel and lube
	Equipment repair
	Ownership cost—machinery
	Ownership cost—equipment
	Machine hire
Other	Vet and medical
	Interest on operating capital
	Ownership cost—livestock
	Ownership cost—land taxes
	Miscellaneous
	Grinding and mixing
	Antibiotics
	Vet service
	Vet supplies
	Growth stimulant
	Utilities
	Legal fees
Transportation and marketing	Trucking
	Marketing
	Hauling and marketing
	Livestock hauling
	Sales commission
	Hauling
Ownership	Machinery
	Equipment
	Livestock
	Land taxes

Table 70. Actual aggregated costs for selected representative budgets[a]

Budget Number	Livestock Activity Type	Costs				
		PUD[b]	Labor	Machinery	Other Production	Transportation
65	Beef cow-yearling (200 head)	1,056.77	10,272.95	18,618.70	39,122.59	1,051.20
77	Beef cow-calf-yearling (150 head)	724.01	5,980.17	8,390.03	16,727.62	451.56
102	Beef cow-calf (78 head)	385.60	7,122.29	8,630.80	14,725.56	561.00
320	Dairy (56 head)	8,154.6	15,945.40	15,035.08	16,847.68	1,697.66
491	Farrow-to-finish pork (300 head)	702.6	3,863.16	8,978.85	2,955.56	89.00
535	Feeder pig finishing pork (300 head)	3,712.0	6,681.60	14,539.60	5,539.16	664.00
554	Feeder pig production pork (300 head)	160.05	3,238.56	6,157.61	2,707.01	8.00
561	GFB finishing (35 steer calves)	368.0	1,712.16	3,853.66	1,138.46	673.00
563	GFB finishing (35 yearling steers)	385.0	1,294.56	2,978.77	902.39	766.00
566	GFB finishing (35 yearling heifers)	333.0	1,002.24	2,808.52	667.99	707.00
569	GFB finishing (140 heifer calves)	1,295.0	4,259.52	10,781.35	3,657.37	2,520.00

[a]These costs are all in 1979 dollars.

[b]PUD = Production unit division = (lbs. of final product sold/100).

[c]These costs are totals for a given budget and should be divided by PUD to get costs/cwt of final product.

for each activity. These factors are then converted to activity coefficients according to the following formula:

$$C_{ji} = (F_j) * (.0012) * (100)$$

where:

j represents livestock type and;

i represents the production activity;

C_{ji} is the matrix coefficient;

F_j is the conversion factor for livestock type j; and

.0012 converts to acre ft/lb; (* 100 = acre ft/cwt).

Thus, the water coefficients for any activity represents the number of acre-feet of water per year required to produce 100 pounds of primary output from that activity.

A joint-product of the production activities is nitrogen. Each activity produced a certain quantity of nitrogen in the form of manures and other byproducts. The quantity of nitrogen available for fertilizer from these wastes varies depending on the time spent in each of the five different feeding systems as explained by Short and Dvoskin (1977). Nitrogen values are calculated by determining the total nitrogen supplied by the number of animals represented in the activity and the percentage of the production year when those animals are present (ie., supplying manure). Once again this total nitrogen supply is divided by the cwt. of primary production produced for the budget to determine the number of pounds of nitrogen produced per cwt. of primary production.

Table B.2 of Appendix B lists the nitrogen conversion factors that were used in developing the nitrogen supply coefficients. These conversion factors are then transformed into the production activity coefficients using the following formulas:

(1) Grain-fed beef production activities

$$\text{Nitrogen coef} = (\text{days on feed}) * (\#\ \text{feeders}) * \frac{(\text{conversion factor})}{\text{PUD}^{10}}$$

= # of nitrogen produced per cwt. of finished beef.

(2) Feeder beef and dairy production activities

Nitrogen coef = (activity multiplier) * (conversion factor)

= # of nitrogen produced per cwt. of feeder beef (milk)

Where the activity multiplier is calculated as follows;

Activity multiplier = [(# of cows before culling) * (% of yr. on farm)

+ (# of cows after culling) * (% yr. on farm)]

÷ PUD

(3) Pork production activities (two methods depending on activity type

a. Farrow-to-finish and feeder pig finishing activities

Nitrogen coef = (1.418) * (conversion factor)

= # of nitrogen produced per cwt. of liveweight pork

Where:

1.418 represents the conversion of dressed pork to liveweight pork based on a 70.5% dressing percentage.

b. Feeder pig production activities

Nitrogen coef = (1.418 * (conversion factor) * (F_1)

= # of nitrogen produced per cwt of liveweight pork

Where F_i represents the quantity of pork produced per cwt. of feeder pigs (i.e. culls).

Final coefficients: Summaries by budget and region of the livestock activities are shown in Appendix C. Included in these tables are energy use estimates (Table C.1) and the objective function values (Table E.1). The data in these two tables when divided by the production unit divisor provide estimates on energy requirement and capital needs per unit of production. Base nutrient demands, offspring requirements/production, and water requirements are shown by activity type (Appendix C, Tables C.3 through C.7).

Feed Transfer Activities

The nutrient requirements of the livestock produced are met through the transfer of nutrients from 13 alternative supplies represented by 10 crops, 2 pastures, and a calcium and phosphorus purchasing activity. These 13 alternative supplies provide the following nutrients;

1. Crude protein (kilograms/transfer unit)
2. Net energy (calories/transfer unit)
3. Calcium (grams/transfer unit)
4. Phosphorus (grams/transfer unit)

5. Metabolizable energy (sugar calories/transfer unit)

6. Lysine (grams/transfer unit)

These activities are listed in Table 71. At the present time only the pasture transfer activities (11 and 12) are allowed to vary in nutrient value content between market regions. The other feed transfer activities provide fixed amounts of the aforementioned nutrients to the production of livestock (metabolizable energy and lysine to pork activities only) based on calculations using feed stuff vales contained in the NRC guide to nutrient requirements. The fixed transfer activity coefficients are listed in Table D.1 of Appendix D. The following formula is used to convert the nutrient values found in the National Academy of Sciences' Guides to Nutrient Requirements into coefficient values;

$$\text{coeff value} = (U_j) * (DM_j) * (V_{ijk}) * (C_k)$$

where:

U_j represents the pounds per unit of feedstuff j (i.e., 56 lbs/bu for corn).

DM_j represents the dry matter percentage of feedstuff j.

V_{ijk} represents the NRC value of feedstuff j to livestock type i for nutrient k; and

C_k represents the conversion of units to find units for coefficients.

An example of actual coefficient development for the fixed feed transfer activities is provided in Table D.2 of Appendix D.

The values of the coefficients for the pasture transfer activities, however, are dependent upon the region where the pasture is being utilized. This distinction in the pasture transfer activities was made

Table 71. The feed transfer activity types

Activity Code	Feed Name	Transfer Unit
JBRL	Barley	Bushel
JCRN	Corn	Bushel
JCSL	Corn silage	Ton
JHLH	Legume hay	Ton
JNLH	Nonlegume hay	Ton
JOTS	Oats	Bushel
JSRG	Sorghum	Bushel
JSSL	Sorghum silage	Ton
JSBN	Soybeans	Bushel
JWHT	Wheat	Bushel
JPRI	Private pasture	Ton
JPUP	Public pasture	Ton
JCBY	Calcium and phosphorus buying	Pounds

because it was felt that the nutrient values supplied by grazed forages varied considerably from one region to another. This could have important implications from the standpoint of minimizing the costs of production since costs of producing a ton of pasture varies considerably across production areas and the nutrients available should reflect those different costs. Appendix D contains the method used to develop the pasture nutrient values. The costs of privately owned pasture are originally derived from a publication entitled, Outlook and Situation Summary Farm Real Estate (Statistical Reporting Service, 1980). In this publication, per head grazing rates are provided by state. These values are converted to dollars per A.U.M. and then to dollars per ton in the western states. The eastern states contain information on rental of an acre of pasture. These data were converted to dollars per ton using the yields specified in Appendix D (Table D.7). The objective function values for the private pasture transfer activities are shown in Table D.5. The limited amount of public pasture available is assumed to be only available to the beef cow/calf activities and the cost of public pasture is assumed constant at $7.20 per ton.[11]

Tables D.3 and D.4 of Appendix D contains the calculated nutrient coefficients for the variable pasture transfer activities to beef and dairy production. The assumption has been made that the nutrient values that were calculated for private pasture fed to beef can be used for the public pasture transfer activities as well. More information on how the variable pasture transfer activity coefficients are developed can be found in Disney and English (1984).

The only other feed transfer activities that require the value of the objective function coefficient to be determined prior to running the model are the silage transfer activities and the calcium/phosphorus buying activities. These cost coefficients are differentiated from other cost coefficients[12] because of the difficulty of obtaining these within the model and because this differentiation forces the model to take into account the extra costs associated with feeding corn or sorghum silage that are not associated with feeding corn or sorghum. The calcium/phosphorus buying activity allows the model to purchase commercial calcium/phosphorus to supplement that available through crops at a constant cost of 26¢ per gram. This avoids the problem of over-feeding of crops to livestock just to meet calcium/phosphorus requirements. A procedure using the Feds budget system was used to develop an average cost of silage for each market region. These average values are listed in Table D.6 of Appendix D.

The Matrix

The livestock production and feed transfer activities are combined to form a large linear programming matrix that, unfortunately, cannot be effectively reproduced in this text. However, the essential details of the model can be represented with a partial matrix for a single LPA. Figure 17 represents a matrix schematic for a representative market region that includes one production activity (using representative budgets) for each livestock production type and the feeder transfer

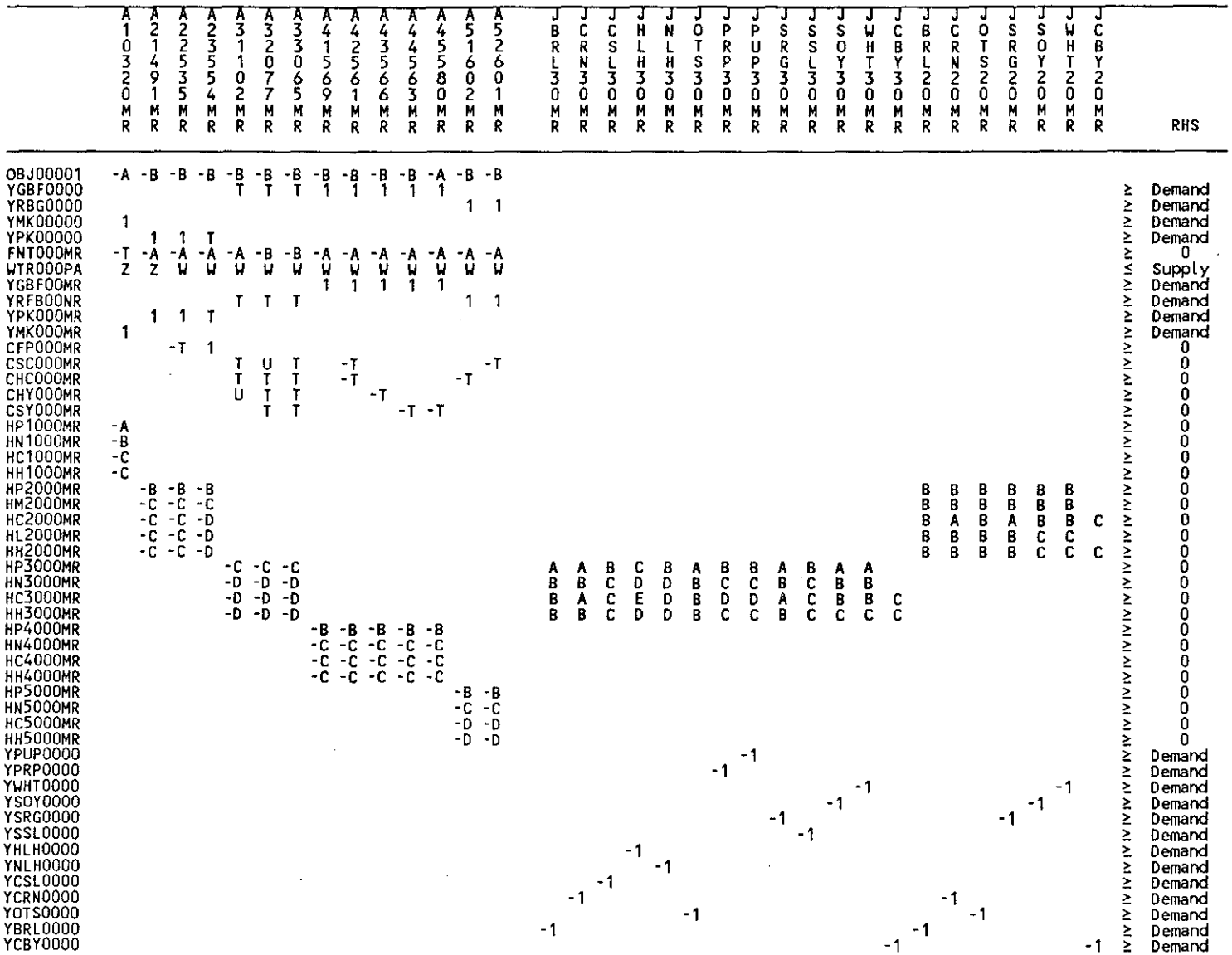

Figure 17. Representative matrix schematic for a given market region with each livestock type and feed transfer activities for feeder beef and pork

activities for feeder beef (livestock activity = 3) and pork (livestock activity = 2).

All production activity labels consist of eight characters with the first three being those (see Table 63) representing livestock production type. The next three characters represent the FEDS budget number used in the development of the activity. Finally, the last two characters represent the LPA where that production activity is located.

The first four characters of the labels for the feed transfer activities (shown in Table 8) represent the feed type. The fifth character in the feed transfer activity label represents the livestock activity type (1 = dairy, ... 5 = roughage-fed beef) that the feed is being transferred to. And, the final characters represent the LPA where the livestock production is to occur.

The constraints that are shown in Figure 17 can be defined as follows:

OBJ00001 : Objective function value

YGBF0000 : National grain-fed beef accounting row

YRGB0000 : National roughage-fed beef accounting row

YMK00000 : National milk accounting row

YPK00000 : National pork accounting row

FNT000MR : Market region nitrogen constraint

WTR000PA : Water constraint for each producing area in the MR

YGBF00MR : Market region grain-fed beef constraint

YRBF00MR : Market region roughage-fed beef constraint

YMK000MR : Market region milk constraint

YPK000MR : Market region pork constraint

CFP000MR : livestock production area feeder pig constraint

CSC000MR : Livestock production area steer calf constraint

CHC000MR : Livestock production area heifer calf constraint

CHY000MR : Livestock Production area heifer yearling constraint

CSY000MR : Livestock production area steer yearling constraint

HPi000MR : LPA crude protein constraint for activity type i
(i=1,2,3,4,5)

HNi000MR : LPA net energy constraint for activity type i (i=1,2,3,4,5)

HCi000MR : LPA calcium constraint for activity type (i (i=1,2,3,4,5)

HHi000MR : LPA phosphorus constraint for activity type i (i=1,2,3,4,5)

YPUP00MR : Market region public pasture constraint

YPRP00MR : Market region private pasture constraint

YWHT00MR : Market region wheat constraint

YSOY00MR : Market region soybean constraint

YSRG00MR : Market region sorghum constraint

YSSL00MR : Market region sorghum silage constraint

YHLH00MR : Market region legume hay constraint

YNLH00MR : Market region non-legume hay constraint

YCSL00MR : Market region corn silage constraint

YCRN00MR : Market region corn constraint

YOTS00MR : Market region oats constraint

YBRL00MR : Market region barley constraint

YCBY00MR : MR calcium and phosphorus purchase accounting row

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APPENDIX A

REPRESENTATIVE EXAMPLES OF FIELD REQUIREMENT CALCULATIONS

Table A.1. Example of the calculation of nutrient requirements for representative dairy budget #320

Activity[a] Components	Requirements[b] Crude Protein (kg)	NE Maintenance (Mcal)	NE Gains (Mcal)	Calcium (gr)	Phosphorous (gr)
Heifer calves:					
7 born 2/15	62.37	456.75	302.4	3,452.4	1,890
+7 born 5/15	285.25	1,821.96	1,184.8	13,384	7,182
+7 born 8/15	586.88	3,742.68	2,205	25,172	14,186
+7 born 11/15	976.99	63,315	3,438.33	38,416	23,079
Replacement heifers:					
20 (<500 lb)	3,672	23,760	12,086	136,800	86,400
26 (<500 lb)	7,216.3	51,948	22,276.8	224,640	168,480
Cows:					
Maintenance during dry and lactation periods	13,990.3	252,511.2	--	587,520	461,040
Milk production (369,821 kg milk)	30,325.3	--	2,551,765	961,534.6	647,186.8
Bulls:					
One	275.76	3,866.4	--	8,280	6,120
Totals	57,391.2	344,438.5	296,679.8	1,999,199	1,415,513.8
Totals ÷ PUD[c] = Activity coeffs	7,038	42.239	36.382	245.163	173.59

[a]This budget is for a 68-cow dairy operation.

[b]Total requirements based on key feeding rates calculated from FED budget information.

[c]PUD = Production unit division = Totals lbs of primary product sold ÷ 100 (=8,154.56 for #320).

Table A.2. Example of the calculation of nutrient requirements for representative feeder beef budget #102

Activity[a] Components	Requirements[b] Crude Protein (kg)	NE Maintenance (Mcal)	NE Gains (Mcal)	Calcium (gr)	Phosphorous (gr)
Steer calves (51)	5,425.4	32,553.3	19,772.7	248,115	187,221
Heifer calves sold (26	2,665.5	15,358.2	10,597.6	120,926	89,648
Heifer calves retained (24)	4,294.6	28,070.4	15,324	154,320	123,648
Cows after cull (105.59)	14,539.7	250,100.5	0	443,953.2	443,953.2
Cows before cull (126)	7,660.8	93.555	0	236,250	236,250
Yearling heifers (20.41) after cull	3,858.5	36,729.8	6,792.4	86,701.7	86,701.7
Yearling heifers (24 before cull	1,207.2	9,991.2	4,051.2	25,200	25,200
Bulls (5)	1,807	21,170	0	38,325	38,325
Totals	41,458.7	487,528.4	56,537.9	1,353,790.7	1,230,946.9
Totals ÷ PUD[c] = Activity coeff's	107.5	1,264.3	146.6	3,510.9	3,192.3

[a]This budget is for a 78 head cow-calf operation.

[b]Details on calculations for all activity coefficients, cull rates, and death losses were obtained from FEDS budget information.

[c]PUD = Production unit division = Totals lbs. of beef sold ÷ 100 (= 385.6 for #102).

Table A.3. Example of the calculation of nutrient requirements for representative finished beef budget #569[a]

Weight Range (lbs.)	Requirements (per head) Crude Protein (kg.)	NE Maintenance (Mcal)	NE Gains (Mcal)	Calcium (gr)	Phosphorous (gr)
425-441	4.32	26.4	20.8	184	136
441-551	35.96	237.8	187.34	1,276	986
551-661	37.7	280.72	220.98	1,218	986
661-772	40.6	321.9	253.46	1,102	986
772-882	44.6	361.92	284.78	986	986
882-925	18.17	158.47	124.89	391	391
Totals	181.41	1,387.21	1,092.25	5,157	4,471
Totals (# of head)	25,397.4	194,209.4	152,915	721,980	625,940
÷ PUD[b] = Activity coeff's	19.61	149.97	118.08	557.51	483.35

[a]This budget finishes 140 heifers from 425 to 925 pounds at an average daily gain of 1.9 lbs.

[b]PUD = production unit division = (# of hd) * (mkt weight)/100 =1295 for #569).

APPENDIX B

WATER USE AND NITROGEN SUPPLY COEFFICIENT DEVELOPMENT

Table B.1. Livestock water conversion factors (Factor times annual production provides gallons water requirement)

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef
1	1	0.0028	0.0090	0.0150
1	2	0.0028	0.0090	0.0150
1	3	0.0028	0.0090	0.0150
1	4	0.0028	0.0090	0.0150
1	5	0.0028	0.0090	0.0150
1	6	0.0028	0.0090	0.0150
2	7	0.0028	0.0090	0.0150
2	8	0.0028	0.0135	0.0150
2	9	0.0028	0.0120	0.0150
2	10	0.0028	0.0090	0.0150
2	29	0.0028	0.0090	0.0150
3	11	0.0032	0.0105	0.0150
3	12	0.0032	0.0090	0.0250
3	13	0.0032	0.0090	0.0250
4	14	0.0036	0.0090	0.0250
4	15	0.0036	0.0105	0.0250
4	37	0.0036	0.0090	0.0250
5	16	0.0036	0.0120	0.0350
5	17	0.0036	0.0135	0.0350
6	28	0.0028	0.0090	0.0150
6	30	0.0028	0.0090	0.0250
6	31	0.0032	0.0090	0.0250
6	32	0.0028	0.0075	0.0150
6	33	0.0036	0.0090	0.0250
7	25	0.0028	0.0075	0.0150
7	26	0.0028	0.0075	0.0150
7	27	0.0028	0.0075	0.0150
8	34	0.0036	0.0090	0.0250
8	35	0.0028	0.0075	0.0150
8	36	0.0036	0.0090	0.0250
9	18	0.0040	0.0105	0.0250
9	19	0.0044	0.0105	0.0250
9	20	0.0048	0.0105	0.0250
9	38	0.0040	0.0090	0.0250
10	22	0.0028	0.0075	0.0150
10	39	0.0028	0.0075	0.0250
10	47	0.0032	0.0090	0.0350
11	23	0.0028	0.0075	0.0150
11	24	0.0028	0.0075	0.0150
11	40	0.0028	0.0075	0.0150
12	41	0.0028	0.0075	0.0150
12	42	0.0028	0.0075	0.0150
13	43	0.0032	0.0090	0.0150
13	44	0.0040	0.0105	0.0250

Table B.1. Continued

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef
13	61	0.0036	0.0105	0.0250
14	21	0.0048	0.0120	0.0250
14	45	0.0044	0.0120	0.0250
14	46	0.0044	0.0135	0.0250
14	69	0.0040	0.0120	0.0350
15	56	0.0032	0.0075	0.0350
15	57	0.0032	0.0075	0.0250
15	59	0.0032	0.0075	0.0350
15	60	0.0032	0.0090	0.0150
16	52	0.0032	0.0075	0.0350
16	53	0.0032	0.0075	0.0250
17	55	0.0032	0.0075	0.0350
17	58	0.0032	0.0075	0.0350
18	63	0.0032	0.0075	0.0350
18	64	0.0036	0.0105	0.0250
18	66	0.0036	0.0090	0.0350
18	68	0.0036	0.0090	0.0350
19	70	0.0036	0.0120	0.0450
19	71	0.0036	0.0105	0.0450
19	73	0.0036	0.0105	0.0450
20	75	0.0036	0.0105	0.0450
20	76	0.0036	0.0105	0.0450
20	81	0.0036	0.0105	0.0450
21	65	0.0036	0.0090	0.0350
21	67	0.0036	0.0090	0.0350
21	72	0.0036	0.0105	0.0450
21	74	0.0036	0.0105	0.0450
21	79	0.0036	0.0105	0.0450
21	80	0.0036	0.0105	0.0350
22	48	0.0032	0.0090	0.0350
22	50	0.0032	0.0090	0.0350
22	51	0.0032	0.0090	0.0350
23	54	0.0032	0.0090	0.0350
23	62	0.0032	0.0090	0.0350
23	82	0.0028	0.0090	0.0450
23	83	0.0028	0.0090	0.0350
24	77	0.0032	0.0105	0.0350
24	78	0.0032	0.0105	0.0450
24	84	0.0032	0.0090	0.0450
24	85	0.0028	0.0090	0.0550
25	49	0.0032	0.0090	0.0350
25	92	0.0032	0.0090	0.0350
26	94	0.0028	0.0090	0.0350
26	95	0.0032	0.0090	0.0350
27	88	0.0028	0.0105	0.0450
27	89	0.0028	0.0105	0.0550

Table B.1. Continued

Livestock Producing Area	Crop Producing Area	Milk	Pork	Beef
27	90	0.0028	0.0105	0.0550
28	86	0.0028	0.0090	0.0550
28	87	0.0028	0.0090	0.0550
29	93	0.0028	0.0090	0.0350
29	96	0.0028	0.0090	0.0150
29	97	0.0028	0.0090	0.0150
29	98	0.0028	0.0090	0.0350
30	91	0.0028	0.0105	0.0450
30	99	0.0028	0.0105	0.0150
30	100	0.0028	0.0105	0.0250
30	102	0.0028	0.0105	0.0150
31	101	0.0028	0.0105	0.0250
31	103	0.0028	0.0105	0.0250
31	104	0.0028	0.0105	0.0450
31	105	0.0028	0.0105	0.0450

Table B.2. Nitrogen equivalent animal waste factors

Livestock Producing Region	Beef Cattle	Beef Feeders	Dairy	Pork
1	52.2	0.073	85.7	2.5
2	52.2	0.084	85.7	2.5
3	16.2	0.076	75.5	1.5
4	16.2	0.076	75.5	1.5
5	16.2	0.076	75.5	1.5
6	52.2	0.081	85.7	2.6
7	52.2	0.082	85.7	2.6
8	52.2	0.081	85.7	2.6
9	16.2	0.079	75.5	1.5
10	52.2	0.079	85.7	2.6
11	52.2	0.082	85.7	2.6
12	52.2	0.081	85.7	2.6
13	52.2	0.077	79.6	2.2
14	16.2	0.075	71.4	1.8
15	52.2	0.081	83.6	2.5
16	47.8	0.079	84.7	2.6
17	47.8	0.079	83.6	2.5
18	0.8	0.074	71.4	1.8
19	0	0.071	71.4	1.8
20	0	0.071	71.4	1.8
21	0	0.075	71.4	1.8
22	43.3	0.079	83.6	2.5
23	37.3	0.079	83.6	2.5
24	15.7	0.079	71.4	1.7
25	43.3	0.079	83.6	2.5
26	37.3	0.079	84.7	2.3
27	31.3	0.079	83.6	2.5
28	15.0	0.079	75.8	1.9
29	31.3	0.079	85.7	2.1
30	31.3	0.079	85.7	2.1
31	31.3	0.079	71.4	1.7

APPENDIX C

INDIVIDUAL ACTIVITY COEFFICIENTS

Table C.1. Continued

Budget File Number	Gasoline	Liquid Petroleum Gas	Diesel	Electric
	(gallons cubic-feet)	(gallons)	(gallons)	(kilowatt hours)
121	811.4	0.0	434.2	22.1
124	583.9	0.0	507.6	22.1
125	924.9	0.0	777.6	380.9
127	759.6	0.0	443.5	22.1
128	1,637.2	0.0	383.0	358.8
129	3,660.0	0.0	2,116.1	717.6
130	1,019.0	0.0	129.6	22.1
131	1,441.5	0.0	781.2	220.8
132	2,376.1	0.0	2,023.2	552.0
133	480.6	0.0	256.8	2,063.8
134	1,348.1	0.0	734.4	4,703.4
136	593.8	0.0	1,195.2	2,939.1
137	1,902.4	0.0	613.4	9,255.7
139	684.2	0.0	121.0	1,950.9
140	1,549.0	0.0	470.4	6,183.1
141	1,246.4	0.0	873.6	10,268.3
142	510.8	0.0	325.9	2,263.8
252	NU	NU	NU	NU
253	NU	NU	NU	NU
254	2,647.5	0.0	0.0	0.0
255	6,477.5	0.0	1,048.6	0.0
256	18,518.5	0.0	1,296.0	0.0
257	NU	NU	NU	NU
258	NU	NU	NU	NU
259	NU	NU	NU	NU
260	NU	NU	NU	NU
261	NU	NU	NU	NU
262	NU	NU	NU	NU
263	922.5	0.0	453.6	0.0
265	2,127.5	0.0	255.6	0.0
266	867.5	0.0	0.0	0.0
268	1,977.5	0.0	0.0	0.0
269	NU	NU	NU	NU
270	NU	NU	NU	NU
271	NU	NU	NU	NU
272	657.5	0.0	473.5	0.0
273	1,330.0	0.0	583.2	0.0
274	2,142.5	0.0	604.8	0.0
275	2,142.5	0.0	77.8	0.0
276	1,080.0	0.0	233.3	0.0
277	1,727.5	0.0	338.6	0.0
278	1,315.0	0.0	339.1	0.0
279	2,105.0	0.0	1,180.8	0.0

Table C.1. Continued

Budget File Number	Gasoline	Liquid Petroleum Gas	Diesel	Electric
	(gallons) cubic-feet)	(gallons)	(gallons)	(kilowatt hours)
280	3,352.5	0.0	1,213.2	0.0
281	572.5	0.0	297.8	0.0
283	NU	NU	NU	NU
301	4,411.2	0.0	75.3	9,726.4
302	4,696.7	0.0	667.3	19,878.6
303	7,931.8	0.0	3,571.7	53,313.6
304	2,691.3	0.0	151.0	9,349.6
305	3,385.7	0.0	361.2	11,465.0
306	3,014.3	0.0	295.7	7,202.9
307	2,068.3	0.0	417.6	6,449.7
308	3,345.6	0.0	434.4	8,473.3
309	2,214.9	0.0	292.0	6,466.1
310	2,198.9	0.0	94.1	4,518.7
311	2,449.5	0.0	305.1	9,429.7
312	7,314.6	0.0	319.2	14,244.2
313	2,271.1	0.0	262.9	6,973.0
314	1,899.2	0.0	424.2	7,257.0
315	2,631.1	0.0	241.9	6,236.1
316	2,029.1	0.0	209.3	7,350.2
317	4,194.4	0.0	649.5	21,324.3
318	4,076.0	0.0	829.6	12,919.6
319	4,726.0	0.0	3,124.2	16,616.8
320	1,679.1	0.0	241.6	8,013.6
491	225.0	448.1	684.6	9,633.0
492	487.5	1,398.6	1,139.5	30,641.0
493	37.5	0.0	104.2	977.0
494	230.0	136.1	418.7	5,808.0
495	225.0	344.4	626.8	9,372.0
496	490.0	759.1	996.9	29,528.0
497	2,492.5	2,408.8	1,292.7	69,954.0
498	37.5	0.0	104.4	1,903.0
499	125.0	138.1	404.8	7,676.0
500	225.0	171.8	629.9	9,281.0
501	490.0	759.1	778.8	28,177.0
502	2,492.5	2,408.8	1,292.7	58,976.0
503	3,770.0	6,442.2	3,183.0	227,392.0
504	37.5	0.0	104.6	2,776.0
505	125.0	276.9	404.8	7,690.0
506	225.0	0.0	629.9	6,653.0
507	225.0	344.4	629.9	9,368.0
508	487.5	1,398.6	1,135.3	30,606.0
509	2,492.5	5,118.4	1,197.1	88,828.0
510	3,770.0	13,688.7	3,183.0	229,095.0

Table C.1. Continued

Budget File Number	Gasoline	Liquid Petroleum Gas	Diesel	Electric
	(gallons cubic-feet)	(gallons)	(gallons)	(kilowatt hours)
511	107.5	0.0	67.2	1,979.0
512	382.5	0.0	232.8	4,233.0
513	765.0	166.3	350.4	6,993.0
514	920.0	584.3	588.0	13,084.0
515	1,522.5	589.3	841.8	43,442.0
516	4,860.1	3,126.8	1,705.4	225,115.0
517	110.0	0.0	99.8	1,853.0
518	382.5	0.0	341.3	2,327.0
519	765.0	0.0	350.4	4,551.0
520	920.0	225.3	971.5	32,578.0
521	1,522.5	590.1	1,259.4	68,306.0
522	697.5	0.0	285.6	1,788.0
523	695.0	860.2	555.8	21,753.0
524	727.5	1,448.8	722.9	37,228.0
525	652.5	0.0	1,176.0	11,004.0
526	210.0	0.0	557.8	2,624.0
527	652.5	0.0	1,176.0	5,799.0
528	85.0	0.0	362.9	1,871.0
529	210.0	0.0	557.8	2,624.0
530	652.5	0.0	1,176.0	5,798.0
531	1,090.0	0.0	414.7	11,972.0
532	85.0	0.0	329.3	3,617.0
533	210.0	0.0	557.8	4,937.0
534	652.5	0.0	1,176.0	11,003.0
535	1,090.0	0.0	414.7	20,558.0
536	3,402.5	0.0	2,269.4	97,803.0
537	297.5	0.0	201.6	2,384.0
538	320.0	0.0	386.4	6,932.0
539	795.0	0.0	940.8	40,478.0
540	297.5	0.0	201.6	2,384.0
541	795.0	0.0	940.8	36,500.0
544	185.0	324.2	400.8	8,692.0
545	262.5	1,359.7	619.2	23,116.0
546	320.0	1,359.7	679.2	23,128.0
547	150.0	0.0	194.9	2,198.0
548	185.0	324.2	400.8	8,688.9
549	320.0	1,359.7	679.2	23,128.2
550	662.5	2,571.9	1,266.7	32,014.9
551	185.0	161.7	400.8	6,740.1
552	320.0	716.6	697.2	18,677.5
553	370.0	0.0	297.5	1,892.0
554	360.0	0.0	259.2	6,017.9
555	687.5	513.6	357.6	17,079.1

Table C.1. Continued

Budget File Number	Gasoline	Liquid Petroleum Gas	Diesel	Electric
	(gallons cubic-feet)	(gallons)	(gallons)	(kilowatt hours)
556	347.5	1,021.4	243.4	41,791.6
557	115.0	1,030.8	332.6	41,700.6
561	441.2	0.0	323.0	2,033.6
562	210.0	0.0	552.2	1,973.0
563	141.0	0.0	480.2	1,926.6
564	420.0	0.0	314.4	1,997.2
565	210.0	0.0	522.5	1,958.4
566	141.0	0.0	423.2	1,923.4
567	472.5	0.0	1,604.0	6,793.2
568	307.5	0.0	1,070.2	4,441.1
569	472.5	0.0	1,537.8	6,652.9
570	307.5	0.0	1,070.2	4,454.6
571	532.5	0.0	1,230.1	14,496.9
572	532.5	0.0	850.5	17,047.0
574	355.0	0.0	910.7	9,767.4
575	532.5	0.0	1,233.5	14,120.4
576	532.5	0.0	850.5	16,282.9
577	355.0	0.0	1,199.6	8,128.7
578	355.0	0.0	910.7	9,183.6
579	635.0	0.0	1,923.2	24,914.0
580	425.0	0.0	1,227.6	19,904.6
582	4,451.3	0.0	9,355.2	692,825.0
583	17,972.6	0.0	36,391.2	2,481,925.0
584	39,288.2	0.0	110,993.9	14,748,298.5
585	18,419.4	0.0	43,906.8	1,550,361.5
586	86,999.4	0.0	168,477.8	5,985,086.9
587	13,180.5	0.0	51,392.8	1,030,228.6
588	29,869.2	0.0	106,607.9	3,778,426.1
600	1,455.8	0.0	432.0	110.4
601	575.0	0.0	302.4	29.3
602	1,455.8	0.0	432.0	110.4
603	575.0	0.0	302.4	29.3
604	919.0	0.0	648.0	183.8
605	745.6	0.0	229.0	1,485.0
606	919.0	0.0	648.0	183.8
607	745.6	0.0	229.0	1,485.0
608	2,376.1	0.0	2,023.2	552.0
609	1,019.0	0.0	129.6	22.1
610	1,019.0	0.0	129.6	22.1
611	950.4	0.0	272.2	44.2
612	749.9	0.0	151.2	29.3
613	1,364.9	0.0	604.8	566.6
614	1,800.0	0.0	1,108.8	929.0

Table C.1. Continued

Budget File Number	Gasoline	Liquid Petroleum Gas	Diesel	Electric
	(gallons) cubic-feet)	(gallons)	(gallons)	(kilowatt hours)
615	950.4	0.0	272.2	44.2
616	749.9	0.0	151.2	29.3
617	1,364.9	0.0	604.8	566.6
618	1,800.0	0.0	1,108.8	929.0
619	1,348.1	0.0	734.4	4,703.6
620	1,348.1	0.0	734.4	4,703.6
621	759.6	0.0	443.5	22.1
622	657.5	0.0	473.3	0.0
623	2,142.5	0.0	604.8	0.0
624	1,080.0	0.0	233.3	0.0
625	1,727.5	0.0	338.6	0.0
626	759.6	0.0	443.5	22.1
627	657.5	0.0	473.5	0.0
628	1,080.0	0.0	233.3	0.0
629	1,727.5	0.0	338.6	0.0
630	924.4	0.0	777.6	380.9
631	924.4	0.0	777.6	380.9
632	867.5	0.0	0.0	0.0
633	1,977.5	0.0	0.0	0.0
634	1,232.5	0.0	0.0	0.0
635	867.5	0.0	0.0	0.0
636	1,977.5	0.0	0.0	0.0
637	1,232.5	0.0	0.0	0.0
638	4,021.5	0.0	1,224.5	0.0
639	2,197.5	0.0	734.4	0.0
640	6,995.0	0.0	1,080.0	0.0
641	2,197.0	0.0	734.4	0.0
642	2,647.5	0.0	0.0	0.0
643	2,647.5	0.0	0.0	0.0

[a] Not used in the analysis. Prior to using in an energy study, check to see if they should really be empty.

Table C.2. Non-feed costs of production for the four major cost categories by budget file number, 1979

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
	(dollars)			
51	2,394.0	4,449.7	6,115.4	398.8
52	4,728.5	7,174.3	12,450.4	817.7
53	8,167.6	14,405.9	27,256.3	929.1
56	6,512.2	15,458.5	24,080.2	414.8
57	13,693.6	33,758.8	60,077.9	3,043.7
59	2,123.1	4,188.5	5,624.5	312.0
60	4,974.1	11,317.2	14,710.1	429.2
61	11,845.5	28,791.8	48,040.2	1,320.9
64	4,911.4	9,778.5	13,521.7	500.7
65	10,273.0	18,618.7	39,122.6	1,051.2
67	2,872.5	4,961.8	6,529.3	330.6
68	4,760.7	8,866.2	12,132.9	320.4
76	2,716.9	3,168.9	5,666.2	191.4
77	5,980.2	8,390.0	16,727.6	451.6
78	9,771.0	17,022.0	32,970.1	735.8
79	3,632.9	6,911.7	5,985.2	238.0
80	8,367.2	11,200.2	16,747.4	506.1
81	8,853.2	14,497.8	35,461.9	0.0
82	17,580.5	41,998.2	76,696.6	4,495.2
83	32,310.1	33,467.7	147,769.6	3,818.4
85	6,183.3	14,286.2	15,350.3	675.4
89	15,340.0	24,450.0	76,696.3	1,306.5
90	25,431.1	47,328.6	156,829.5	2,784.7
91	9,305.2	10,560.0	19,259.4	610.5
92	11,760.1	12,230.0	38,609.3	1,611.9
93	21,965.6	24,813.8	86,643.5	386.4
94	2,449.1	3,124.5	4,971.0	69.3
95	6,565.1	17,264.6	16,009.1	357.0
96	9,595.9	23,398.0	33,042.3	509.6
102	7,122.3	8,630.8	14,725.6	561.0
103	16,102.5	27,195.5	29,661.9	704.0
104	2,057.9	3,573.3	5,089.4	327.0
105	5,532.0	6,893.2	15,069.2	845.0
106	10,493.1	15,824.3	29,180.6	1,018.0
107	3,258.5	5,347.1	5,395.8	221.0
110	2,705.0	6,470.5	5,109.6	315.0
113	2,998.6	3,996.4	5,202.6	229.0
114	3,955.8	10,293.2	15,133.0	688.0
115	6,331.7	15,148.1	28,944.3	1,355.0
116	8,642.3	18,728.4	71,055.8	3,765.0
117	2,665.1	3,431.6	4,707.1	182.0
119	10,283.8	11,648.0	26,182.8	1,162.0
120	28,272.5	61,318.3	136,419.3	6,778.0
121	2,680.7	4,714.2	4,991.8	303.0

Table C.2. Continued

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
	.....(dollars).....			
124	3,404.9	4,228.8	5,060.7	514.0
125	5,811.6	7,716.1	14,292.5	728.0
127	3,823.8	5,406.4	4,928.0	314.0
128	8,310.4	9,549.5	14,048.8	1,015.0
129	13,965.3	23,674.3	26,627.4	1,799.0
130	2,404.8	4,568.9	5,547.6	166.0
131	13,642.4	9,288.9	32,952.9	1,000.0
132	18,100.8	19,702.4	69,219.1	2,000.0
133	1,792.2	4,140.2	6,275.4	211.0
134	4,872.0	10,838.9	18,513.3	860.0
136	2,513.7	8,706.3	7,445.5	133.0
137	8,452.5	13,779.5	21,673.3	866.0
139	2,779.5	4,283.8	5,348.7	278.0
140	7,472.0	9,924.2	17,035.6	657.0
141	15,565.2	15,675.2	32,696.0	2,552.0
142	2,000.7	5,221.4	6,100.8	279.0
252	9,922.6	15,300.5	30,998.6	1,154.0
253	21,705.6	36,731.6	73,597.1	2,527.0
254	12,980.9	19,592.1	32,675.0	1,396.0
255	26,440.9	43,598.7	75,436.4	2,327.0
256	40,293.0	91,049.8	181,690.9	5,225.0
257	7,150.1	16,373.5	16,141.1	532.0
258	9,776.6	22,267.7	30,599.4	1,434.0
259	37,392.0	67,187.6	148,541.0	4,612.0
260	4,815.4	10,126.3	15,263.7	534.0
261	7,040.6	16,825.5	30,261.6	1,106.0
262	18,677.8	50,081.8	156,267.0	5,324.0
263	2,366.6	6,475.7	5,658.6	314.0
265	11,127.4	16,550.7	32,993.2	813.0
266	3,393.0	5,750.5	5,854.1	233.0
268	12,480.0	15,972.9	32,784.1	1,048.0
269	7,449.0	7,253.0	18,132.6	756.0
270	10,998.0	15,381.1	32,540.3	1,783.0
271	44,265.0	40,547.2	198,890.4	4,034.0
272	3,159.0	5,270.8	5,208.4	310.0
273	3,978.0	10,736.3	15,524.4	604.0
274	18,213.0	18,569.9	65,823.4	1,342.0
275	3,446.2	8,236.9	5,408.3	288.0
276	4,608.7	8,377.5	15,065.7	821.0
277	6,809.3	13,347.1	29,421.2	1,486.0
278	6,084.0	9,399.9	16,780.2	893.0
279	11,037.0	17,378.9	31,842.2	1,614.0
280	22,347.0	29,767.3	72,684.4	3,573.0
281	2,379.0	4,136.3	6,119.7	277.0

Table C.2. Continued

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
	(dollars)			
283	8,892.0	12,686.2	33,900.7	1,104.0
301	31,356.0	21,497.0	24,952.1	7,124.4
302	83,767.1	73,224.7	155,842.2	29,115.6
303	36,362.9	25,698.4	50,970.8	10,276.6
304	17,542.2	17,489.3	14,925.5	3,803.8
305	19,063.4	22,509.6	17,435.8	4,359.5
306	18,618.7	18,224.7	17,518.3	3,890.3
307	18,605.2	14,480.9	16,602.8	4,336.6
308	23,952.3	21,668.0	22,062.8	5,364.7
309	16,780.0	17,224.5	12,902.3	2,270.9
310	16,471.6	13,135.0	15,356.0	3,787.8
311	20,206.6	16,974.9	20,742.6	3,348.8
312	31,460.5	32,441.4	32,239.0	7,704.8
313	18,584.8	16,029.5	15,931.5	4,266.6
314	20,264.5	15,619.1	18,362.1	4,006.3
315	12,924.4	16,798.1	15,603.2	3,577.8
316	17,285.4	13,310.7	18,697.9	5,892.2
317	37,661.9	22,278.6	46,360.2	14,143.8
318	32,032.9	24,867.7	29,011.4	8,393.4
319	45,476.2	41,659.0	67,658.1	15,520.4
320	15,945.4	15,035.1	16,847.7	1,697.7
491	3,863.2	8,978.9	2,955.6	89.0
492	6,591.5	16,919.4	5,531.6	166.0
493	1,039.7	1,057.6	694.9	23.0
494	3,584.7	5,719.4	1,687.2	78.0
495	4,743.5	8,899.3	2,958.0	86.0
496	8,104.5	16,951.3	5,577.4	166.0
497	13,894.9	44,045.0	12,912.3	207.0
498	1,010.9	1,625.1	701.3	23.0
499	3,485.4	5,724.6	1,535.6	78.0
500	4,612.1	8,699.0	2,719.2	85.0
501	7,880.0	16,096.8	5,087.9	166.0
502	13,510.0	43,000.6	13,578.0	207.0
503	24,401.5	112,135.5	42,912.9	3,296.0
504	1,002.2	1,685.1	928.8	23.0
505	3,455.6	5,814.3	1,657.8	78.0
506	4,572.7	6,455.0	3,230.0	85.0
507	4,572.7	8,691.8	2,934.8	85.0
508	7,802.2	16,820.1	5,539.4	166.0
509	13,394.5	53,382.3	12,788.9	207.0
510	24,182.5	115,596.4	46,327.1	3,296.0
511	1,000.4	1,529.6	878.9	10.0
512	3,477.0	5,474.8	2,284.2	36.0
513	5,868.2	11,226.0	2,903.8	60.0

Table C.2. Continued

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
			(dollars)	
514	8,338.7	14,720.0	5,488.5	153.0
515	13,609.1	31,693.7	12,564.6	672.0
516	24,589.1	129,261.3	44,224.2	1,020.0
517	996.6	1,629.0	712.9	10.0
518	3,442.8	4,401.9	1,608.3	35.0
519	5,804.4	6,972.1	4,481.3	60.0
520	8,268.8	24,766.6	6,334.4	153.0
521	13,475.2	45,685.3	15,192.4	672.0
522	6,617.0	7,260.2	4,765.3	753.0
523	9,291.8	14,919.2	9,057.1	1,624.0
524	15,119.0	41,902.6	21,227.3	4,002.0
525	4,448.2	11,070.6	2,415.5	363.0
526	2,617.3	5,124.0	1,108.5	195.0
527	5,461.9	10,911.3	2,390.0	363.0
528	2,579.9	3,028.7	544.3	214.0
529	2,544.8	5,062.9	1,102.9	195.0
530	5,310.6	10,762.3	2,376.7	363.0
531	6,739.2	14,468.8	7,029.5	664.0
532	2,557.8	3,103.0	1,195.2	214.0
533	2,523.0	5,169.2	1,108.5	195.0
534	5,265.2	11,106.8	2,388.9	363.0
535	6,681.6	14,539.6	5,539.2	664.0
536	11,842.4	53,951.4	21,902.5	4,362.0
537	2,659.6	4,262.6	2,287.6	23.0
538	4,297.5	9,293.6	2,559.3	142.0
539	6,542.3	28,158.2	7,313.2	1,518.0
540	2,633.4	4,252.3	2,332.8	23.0
541	6,201.0	26,544.2	11,888.2	3,484.0
544	2,457.8	5,080.2	2,658.2	74.0
545	4,762.8	11,087.6	5,285.2	160.0
546	5,938.9	12,071.6	4,228.2	160.0
547	2,557.8	2,356.7	1,132.3	7.0
548	2,909.3	5,095.8	2,648.5	74.0
549	5,888.2	12,179.2	4,217.6	160.0
550	6,107.4	25,247.4	8,245.0	393.0
551	2,733.7	4,921.9	2,619.5	74.0
552	5,532.8	11,703.1	4,148.9	160.0
553	3,257.3	3,293.7	1,510.9	8.0
554	3,238.6	6,157.6	2,707.0	8.0
555	6,383.5	11,923.4	4,093.9	48.0
556	7,828.1	20,862.5	7,762.0	276.0
557	8,154.3	19,603.3	11,821.1	1,002.0
561	1,712.2	3,853.7	1,138.5	673.0
562	2,088.0	3,879.4	1,095.6	673.0

Table C.2. Continued

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
	(dollars)			
563	1,294.6	2,978.8	902.4	766.0
564	1,419.8	3,737.9	993.0	630.0
565	1,753.9	3,756.8	956.2	630.0
566	1,002.2	2,808.5	668.0	707.0
567	5,094.7	11,077.9	4,192.4	2,693.0
568	3,800.2	9,117.2	3,394.0	3,046.0
569	4,259.5	10,781.4	3,657.4	2,520.0
570	2,965.0	8,986.7	2,518.4	2,810.0
571	9,187.2	19,598.8	11,905.4	6,725.0
572	9,187.2	24,109.6	9,831.2	6,719.0
574	6,890.4	18,000.1	8,104.7	7,606.0
575	7,683.8	19,556.0	8,829.4	6,286.0
576	7,683.8	23,553.2	8,563.6	6,292.0
577	5,387.0	13,640.9	6,140.5	7,012.0
578	5,387.0	16,935.6	6,020.4	7,012.0
579	10,105.9	32,849.4	19,203.8	13,449.0
580	7,558.6	20,938.0	15,963.7	15,211.0
582	44,084.8	83,538.9	213,391.2	47,317.0
583	236,109.3	273,244.6	740,796.5	54,626.0
584	364,572.0	602,532.8	0.0	22,741.0
585	116,442.0	281,539.5	552,810.0	77,910.0
586	315,822.0	786,448.0	0.0	76,669.0
587	113,767.0	278,892.0	378,862.0	47,069.0
588	274,775.0	580,772.0	0.0	217,747.0
600	7,128.4	8,635.5	4,476.0	4,629.4
601	3,515.8	3,574.3	1,643.0	1,690.2
602	6,027.4	8,635.5	4,476.0	4,330.4
603	2,966.8	3,574.3	1,643.0	1,581.2
604	7,191.3	6,901.4	4,484.2	4,667.9
605	3,521.3	5,351.5	1,843.2	1,690.2
606	6,081.1	6,901.4	4,484.2	4,366.9
607	2,976.5	5,351.5	1,843.2	1,581.2
608	21,220.0	19,728.9	22,196.5	21,341.0
609	4,262.6	4,570.1	2,123.2	1,574.9
610	3,381.5	4,570.1	2,123.2	1,473.9
611	3,858.8	6,471.4	1,524.9	1,707.5
612	3,327.8	3,997.2	1,580.0	1,613.3
613	7,966.3	10,302.0	4,547.7	5,225.6
614	9,475.6	15,159.2	7,630.6	9,355.0
615	3,267.3	6,471.4	1,524.9	1,599.5
616	2,808.3	3,997.2	1,580.0	1,509.3
617	6,734.2	10,302.0	4,547.7	4,887.6
618	8,590.7	15,159.2	7,630.6	8,751.0
619	8,049.2	10,838.9	6,730.3	4,618.1

Table C.2. Continued

Budget File Number	Labor	Machinery	Other	Transportation and Marketing
	.....(dollars).....			
620	6,709.4	10,838.9	6,730.3	4,937.1
621	3,446.4	5,407.4	1,417.0	1,497.9
622	3,305.3	3,584.6	931.7	1,594.1
623	15,710.5	18,569.9	6,956.9	21,917.2
624	7,255.6	8,377.5	2,670.9	4,475.6
625	9,390.4	13,347.1	4,905.1	8,990.6
626	2,916.8	5,407.4	1,417.0	1,401.9
627	2,752.8	3,584.6	931.7	1,491.1
628	6,048.9	8,377.5	2,670.9	4,186.7
629	8,421.6	13,347.1	4,905.1	8,409.6
630	7,462.0	7,720.2	3,208.4	4,303.5
631	6,316.3	7,720.2	3,208.4	4,025.5
632	3,425.5	5,750.5	1,543.9	1,651.8
633	8,255.0	15,972.9	7,053.3	8,413.5
634	7,371.0	7,253.0	5,515.4	4,840.9
635	2,850.3	5,750.5	1,543.9	1,545.8
636	7,403.5	15,972.9	7,053.3	8,413.5
637	6,142.5	7,253.0	5,515.4	4,840.9
638	33,303.2	50,081.8	27,070.5	49,672.6
639	8,657.9	22,267.7	4,419.7	9,431.9
640	32,221.0	67,187.6	23,141.5	48,055.6
641	7,761.1	22,267.7	4,419.7	8,822.9
642	11,202.2	19,592.2	3,936.4	10,219.4
643	10,040.6	19,592.2	3,936.4	9,560.4

Source: Adapted from the Firm Enterprise Data System (Economic Research Service, 1981).

Table C.3. Nutrient and water requirements and production levels for dairy production, 1979

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:				
			Protein	Net Energy	Calcium	Phosphorous	Silage	Milk	Roughage Beef	Steer Calves	Nitrogen	Water Requirement
								(pounds)				(Gal./Day)
1030101	301	1	6.4	69.6	220.4	155.5	0.0	100.0	1.5	0.3	0.6	0.00336
1031101	311	1	6.7	73.1	229.8	162.5	0.0	100.0	1.7	0.3	0.6	0.00336
1031102	311	2	6.7	73.1	229.8	162.5	0.0	100.0	1.7	0.3	0.6	0.00336
1031402	314	2	7.0	77.4	242.9	171.6	0.0	100.0	1.8	0.3	0.7	0.00336
1031203	312	3	6.8	74.5	207.9	166.2	0.0	100.0	1.6	0.3	0.5	0.00384
1031803	318	3	7.0	77.1	244.4	172.3	0.1	100.0	1.8	0.2	0.6	0.00384
1030304	303	4	7.1	77.7	246.0	174.0	0.0	100.0	2.0	0.3	0.6	0.00432
1031604	316	4	6.8	75.7	238.0	167.9	0.0	100.0	1.8	0.3	0.6	0.00432
1031804	318	4	7.0	77.1	244.4	172.3	0.1	100.0	1.8	0.2	0.6	0.00432
1030305	303	5	7.1	77.7	246.0	174.0	0.0	100.0	2.0	0.3	0.6	0.00432
1030506	305	6	7.0	76.4	242.0	170.3	0.0	100.0	1.8	0.2	0.6	0.00352
1030706	307	6	7.1	79.4	247.4	175.3	0.0	100.0	1.9	0.4	0.7	0.00352
1031106	311	6	6.7	73.1	229.8	162.5	0.0	100.0	1.7	0.3	0.6	0.00352
1031206	312	6	6.8	74.5	207.9	166.2	0.0	100.0	1.6	0.3	0.6	0.00352
1031306	313	6	6.9	75.5	238.0	167.9	0.0	100.0	2.1	0.2	0.6	0.00352
1031406	314	6	7.0	77.4	242.9	171.6	0.0	100.0	1.8	0.3	0.7	0.00352
1031806	318	6	7.0	77.1	244.4	172.3	0.1	100.0	1.8	0.2	0.6	0.00352
1030507	305	7	7.0	76.4	242.0	170.3	0.0	100.0	1.8	0.2	0.6	0.00336
1030807	308	7	7.3	80.8	254.2	179.4	0.0	100.0	2.2	0.2	0.7	0.00336
1031307	313	7	6.9	75.5	238.0	167.9	0.0	100.0	2.1	0.2	0.6	0.00336
1030408	304	8	7.1	77.5	245.0	174.8	0.0	100.0	2.1	0.2	0.7	0.00403
1030508	305	8	7.0	76.4	242.0	170.3	0.0	100.0	1.8	0.2	0.6	0.00403
1030708	307	8	7.1	79.4	247.4	175.3	0.0	100.0	1.9	0.4	0.7	0.00403
1031608	316	8	6.8	75.7	238.0	167.9	0.0	100.0	1.8	0.3	0.7	0.00403
1030309	303	9	7.1	77.7	246.0	174.0	0.0	100.0	2.0	0.3	0.6	0.00510
1031609	316	9	6.8	75.7	238.0	167.9	0.0	100.0	1.8	0.3	0.6	0.00510
1030910	309	10	7.2	78.9	248.8	175.4	0.0	100.0	2.1	0.2	0.7	0.00344
1032010	320	10	7.0	78.6	245.2	173.6	0.0	100.0	2.4	0.3	0.7	0.00344
1032011	320	11	7.0	78.6	245.2	173.6	0.0	100.0	2.4	0.3	0.7	0.00336
1030412	304	12	7.1	77.5	245.0	174.8	0.0	100.0	2.1	0.2	0.7	0.00336
1030612	306	12	7.1	79.4	248.5	175.6	0.0	100.0	2.1	0.3	0.7	0.00336

Table C.3. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:				
			Protein	Net Energy	Calcium	Phosphorous	Silage	Milk	Roughage Beef	Steer Calves	Nitrogen	Water Requirement
								(pounds)				(Gal./Day)
1031012	310	12	7.5	84.2	261.2	185.1	0.0	100.0	1.9	0.4	0.8	0.00336
1032012	320	12	7.0	78.6	245.2	173.6	0.0	100.0	2.4	0.3	0.7	0.00336
1030413	304	13	7.1	77.5	245.0	174.8	0.0	100.0	2.1	0.2	0.6	0.00419
1031013	310	13	7.5	84.2	261.2	185.1	0.0	100.0	1.9	0.4	0.7	0.00419
1031613	316	13	6.8	75.7	238.0	167.9	0.0	100.0	1.8	0.3	0.6	0.00419
1030615	306	15	7.1	79.4	248.8	175.6	0.0	100.0	2.1	0.3	0.7	0.00384
1031015	310	15	7.5	84.2	261.2	185.1	0.0	100.0	1.9	0.4	0.6	0.00384
1031516	315	16	7.5	68.7	259.9	183.3	0.0	100.0	2.2	0.2	0.7	0.00384
1031018	310	18	7.5	84.2	261.2	185.1	0.0	100.0	1.9	0.4	0.7	0.00422
1031718	317	18	6.5	72.7	226.4	160.4	0.0	100.0	1.8	0.3	0.6	0.00422
1031719	317	19	6.5	72.7	226.4	160.4	0.0	100.0	1.8	0.3	0.6	0.00432
1031720	317	20	6.5	72.7	226.4	160.4	0.0	100.0	1.8	0.3	0.6	0.00432
1031721	317	21	6.5	72.7	226.4	160.4	0.0	100.0	1.8	0.3	0.6	0.00432
1031724	317	24	6.5	72.7	226.4	160.4	0.0	100.0	1.8	0.3	0.6	0.00384
1031929	319	29	6.3	68.2	216.7	152.7	0.0	100.0	1.2	0.3	0.6	0.00336
1030230	302	30	6.3	68.7	217.9	153.6	0.0	100.0	1.9	0.2	0.6	0.00336
1030231	302	31	6.3	68.7	217.9	153.6	0.0	100.0	1.9	0.2	0.5	0.00336

Source: Adapted from the Firm Enterprise Data System (Economic Research Service, 1981)

[a] Units of nutrients are:
Protein -- kilograms/cwt.
Net energy -- megacalories/cwt.
Calcium -- grams/cwt.
Phospherous -- grams/cwt.

Table C.4. Nutrient and water requirements and production levels for pork production, 1979

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2151103	511	3	25.8	594.5	1,142.9	904.3	1,099.3	100.0		2.1	-0.001114
2151203	512	3	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001114
2151303	513	3	22.8	519.3	972.1	772.8	983.7	100.0		2.1	-0.001114
2151403	514	3	22.7	512.8	949.7	757.6	979.8	100.0		2.1	-0.001114
2151503	515	3	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001114
2151603	516	3	23.0	520.7	965.8	770.1	994.3	100.0		2.1	-0.001114
2355303	553	3	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.6	-0.000317
2355403	554	3	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.5	-0.000264
2355503	555	3	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.5	-0.000257
2355603	556	3	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.4	-0.000214
2253703	537	3	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001114
2253803	538	3	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001114
2253903	539	3	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001114
2151104	511	4	25.8	594.5	1,142.9	904.3	1,099.3	100.0		2.1	-0.001168
2151204	512	4	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001168
2151304	513	4	22.8	519.3	972.1	772.8	983.7	100.0		2.1	-0.001168
2151404	514	4	22.7	512.8	949.7	757.6	979.8	100.0		2.1	-0.001168
2151504	515	4	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001168
2151604	516	4	23.0	520.7	965.8	770.1	994.3	100.0		2.1	-0.001168
2151704	517	4	25.1	579.7	1,117.5	883.2	1,070.9	100.0		2.1	-0.001168
2151804	518	4	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001168
2151904	519	4	24.3	551.8	1,032.9	821.8	1,045.5	100.0		2.1	-0.001168
2152004	520	4	22.9	518.6	961.6	766.9	990.0	100.0		2.1	-0.001168
2152104	521	4	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001168
2253704	537	4	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001168
2253804	538	4	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001168
2253904	539	4	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001168
2355304	553	4	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.6	-0.000332
2355404	554	4	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.5	-0.000277
2355504	555	4	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.5	-0.000270

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2355604	556	4	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.4	-0.000224
2151105	511	5	25.8	594.5	1,142.9	904.3	1,099.3	100.0		2.1	-0.001446
2151205	512	5	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001446
2151305	513	5	22.8	519.3	972.1	772.8	983.7	100.0		2.1	-0.001446
2151405	514	5	22.7	512.8	949.7	757.6	979.8	100.0		2.1	-0.001446
2151505	515	5	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001446
2151605	516	5	23.0	520.7	965.8	770.1	994.3	100.0		2.1	-0.001446
2355305	553	5	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.6	-0.000411
2355405	554	5	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.5	-0.000343
2355505	555	5	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.5	-0.000334
2355605	556	5	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.4	-0.000277
2253705	537	5	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001446
2253805	538	5	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001446
2253905	539	5	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001446
2149806	498	6	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.7	-0.000943
2149906	499	6	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000943
2150006	500	6	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000943
2150106	501	6	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000943
2150206	502	6	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000943
2150306	503	6	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000943
2252806	528	6	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000943
2252906	529	6	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000943
2253006	530	6	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000943
2253106	531	6	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000943
2354606	546	6	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000269
2149807	498	7	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.7	-0.000900
2149907	499	7	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000900
2150007	500	7	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150107	501	7	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150207	502	7	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2150307	503	7	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000900
2252807	528	7	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2252907	529	7	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253007	530	7	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253107	531	7	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2354607	546	7	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2149207	492	7	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2354407	544	7	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.1	-0.000264
2354507	545	7	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2149308	493	8	24.0	549.2	1,031.6	823.8	1,023.7	100.0		3.7	-0.000953
2149408	494	8	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000953
2149708	497	8	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000953
2149808	498	8	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.7	-0.000953
2149908	499	8	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000953
2150008	500	8	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000953
2150108	501	8	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000953
2150208	502	8	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000953
2150308	503	8	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000953
2252808	528	8	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000953
2252908	529	8	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000953
2253008	530	8	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000953
2253108	531	8	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000953
2354608	546	8	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000272
2355308	553	8	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	1.1	-0.000271
2355408	554	8	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.9	-0.000226
2355508	555	8	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.9	-0.000220
2355608	556	8	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.7	-0.000183
2151109	511	9	25.8	594.5	1,142.9	904.3	1,099.3	100.0		2.1	-0.001198
2151209	512	9	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001198
2151309	513	9	22.8	519.3	972.1	772.8	983.7	100.0		2.1	-0.001198
2151409	514	9	22.7	512.8	949.7	757.6	979.8	100.0		2.1	-0.001198

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								.....(Pounds).....			(Gal./Day)
2151509	515	9	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001198
2151609	516	9	23.0	520.7	965.8	770.1	994.3	100.0		2.1	-0.001198
2151709	517	9	25.1	579.7	1,117.5	883.2	1,070.9	100.0		2.1	-0.001198
2151809	518	9	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.1	-0.001198
2151909	519	9	24.3	551.8	1,032.9	821.8	1,045.5	100.0		2.1	-0.001198
2152009	520	9	22.9	518.6	961.6	766.9	990.0	100.0		2.1	-0.001198
2152109	521	9	23.0	521.8	969.6	772.3	994.8	100.0		2.1	-0.001198
2253709	537	9	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001198
2253809	538	9	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001198
2253909	539	9	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.1	-0.001198
2355309	553	9	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.6	-0.000340
2355409	554	9	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.5	-0.000284
2355509	555	9	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.5	-0.000277
2355609	556	9	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.4	-0.000230
2150410	504	10	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.7	-0.000923
2150510	505	10	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000923
2150610	506	10	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000923
2150710	507	10	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000923
2150810	508	10	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000923
2150910	509	10	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000923
2151010	510	10	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000923
2253210	532	10	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000923
2253310	533	10	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000923
2253410	534	10	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000923
2253510	535	10	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000923
2253610	536	10	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000923
2354510	545	10	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000263
2354710	547	10	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.6	-0.000391
2354810	548	10	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.1	-0.000270
2354910	549	10	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000263

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	Water Requirements
								(Pounds)			(Gal./Day)
2355010	550	10	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.9	-0.000218
2149111	491	11	22.9	519.5	959.6	764.9	987.2	100.0		3.7	-0.000900
2149211	492	11	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2149811	498	11	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.7	-0.000900
2150111	501	11	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150211	502	11	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900
2150411	504	11	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.7	-0.000900
2150511	505	11	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000900
2150611	506	11	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150711	507	11	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150811	508	11	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150911	509	11	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900
2151011	510	11	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000900
2252511	525	11	16.0	371.8	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2252811	528	11	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2252911	529	11	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253111	531	11	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2354711	547	11	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.6	-0.000382
2354811	548	11	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.1	-0.000264
2354911	549	11	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2355011	550	11	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.9	-0.000213
2150412	504	12	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.7	-0.000900
2150512	505	12	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000900
2150612	506	12	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150712	507	12	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150812	508	12	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150912	509	12	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900
2151012	510	12	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000900
2253212	532	12	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253312	533	12	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2253412	534	12	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253512	535	12	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253612	536	12	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2354512	545	12	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2354712	547	12	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.6	-0.000382
2354812	548	12	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.1	-0.000264
2354912	549	12	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2355012	550	12	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.9	-0.000213
2149812	498	12	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.7	-0.000900
2149912	499	12	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000900
2150012	500	12	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150112	501	12	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150212	502	12	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900
2150312	503	12	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000900
2149313	493	13	24.0	549.2	1,031.6	823.8	1,023.7	100.0		3.1	-0.001162
2149413	494	13	22.8	517.7	959.6	764.8	981.2	100.0		3.1	-0.001162
2149513	495	13	22.9	519.5	959.6	764.9	987.2	100.0		3.1	-0.001162
2149613	496	13	22.7	510.9	948.6	756.5	980.2	100.0		3.1	-0.001162
2149713	497	13	22.6	512.6	942.5	752.0	978.3	100.0		3.1	-0.001162
2149813	498	13	24.0	549.2	1,031.6	223.8	1,023.7	100.0		3.1	-0.001162
2149913	499	13	22.8	517.7	959.6	764.8	981.2	100.0		3.1	-0.001162
2150013	500	13	22.9	982.2	959.6	764.9	987.2	100.0		3.1	-0.001162
2150113	501	13	22.7	510.9	948.6	756.5	980.2	100.0		3.1	-0.001162
2150213	502	13	22.6	512.6	942.5	752.0	978.3	100.0		3.1	-0.001162
2150313	503	13	23.0	521.4	959.4	769.3	994.2	100.0		3.1	-0.001162
2252813	528	13	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.1	-0.001162
2252913	529	13	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.1	-0.001162
2253013	530	13	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.1	-0.001162
2253113	531	13	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.1	-0.001162
2354613	546	13	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	0.9	-0.000331
2355313	553	13	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.9	-0.000330

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2355413	554	13	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.7	-0.000276
2151713	517	13	25.1	579.7	1,117.5	883.2	1,070.9	100.0		3.1	-0.001162
2151813	518	13	23.7	532.0	1,026.3	813.7	1,017.9	100.0		3.1	-0.001162
2254013	540	13	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	3.1	-0.001162
2151913	519	13	24.3	551.8	1,032.9	821.8	1,045.5	100.0		3.1	-0.001162
2152013	520	13	22.9	518.6	961.6	766.9	990.0	100.0		3.1	-0.001162
2152113	521	13	23.0	521.8	969.6	772.3	994.8	100.0		3.1	-0.001162
2151714	517	14	25.1	579.7	1,117.5	883.2	1,070.9	100.0		2.6	-0.001453
2151814	518	14	23.7	532.0	1,026.3	813.7	1,017.9	100.0		2.6	-0.001453
2151914	519	14	24.3	551.8	1,032.9	821.8	1,045.5	100.0		2.6	-0.001453
2152014	520	14	22.9	518.6	961.6	766.9	990.0	100.0		2.6	-0.001453
2152114	521	14	23.0	521.8	969.6	772.3	994.8	100.0		2.6	-0.001453
2254014	540	14	15.5	358.7	596.0	482.4	675.8	100.0	-24.3	2.6	-0.001453
2355314	553	14	40.7	899.8	2,001.4	1,553.3	1,702.2	28.4	100.0	0.7	-0.000413
2355414	554	14	34.6	750.9	1,669.9	1,298.6	1,459.0	23.7	100.0	0.6	-0.000345
2355514	555	14	35.2	763.6	1,686.4	1,314.1	1,488.9	23.1	100.0	0.6	-0.000336
2355614	556	14	31.8	679.9	1,507.7	1,175.4	1,348.9	19.2	100.0	0.5	-0.000278
2149315	493	15	24.0	549.2	1,031.6	823.8	1,023.7	100.0		3.6	-0.000954
2149415	494	15	22.8	517.7	959.6	764.8	981.2	100.0		3.6	-0.000954
2149515	495	15	22.9	519.5	959.6	764.9	987.2	100.0		3.6	-0.000954
2149615	496	15	22.7	510.9	948.6	756.5	980.2	100.0		3.6	-0.000954
2149715	497	15	22.6	512.6	942.5	752.0	978.3	100.0		3.6	-0.000954
2150415	504	15	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.6	-0.000954
2150515	505	15	22.8	517.7	959.6	764.8	981.2	100.0		3.6	-0.000954
2150615	506	15	22.9	982.2	959.6	764.9	987.2	100.0		3.6	-0.000954
2150715	507	15	22.9	982.2	959.6	764.9	987.2	100.0		3.6	-0.000954
2150815	508	15	22.7	510.9	948.6	756.5	980.2	100.0		3.6	-0.000954
2150915	509	15	22.6	512.6	942.5	752.0	978.3	100.0		3.6	-0.000954
2151015	510	15	23.0	521.4	959.4	769.3	994.2	100.0		3.6	-0.000954
2253215	532	15	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000954

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								(Pounds)			(Gal./Day)
2253315	533	15	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000954
2253415	534	15	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000954
2253515	535	15	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000954
2253615	536	15	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000954
2354715	547	15	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.5	-0.000404
2354815	548	15	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.0	-0.000279
2354915	549	15	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.0	-0.000272
2355015	550	15	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.8	-0.000226
2150416	504	16	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.7	-0.000900
2150516	505	16	22.8	517.7	959.6	764.8	981.2	100.0		3.7	-0.000900
2150616	506	16	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150716	507	16	22.9	982.2	959.6	764.9	987.2	100.0		3.7	-0.000900
2150816	508	16	22.7	510.9	948.6	756.5	980.2	100.0		3.7	-0.000900
2150916	509	16	22.6	512.6	942.5	752.0	978.3	100.0		3.7	-0.000900
2151016	510	16	23.0	521.4	959.4	769.3	994.2	100.0		3.7	-0.000900
2253216	532	16	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253316	533	16	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253416	534	16	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253516	535	16	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2253616	536	16	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.7	-0.000900
2354516	545	16	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2354716	547	16	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.6	-0.000382
2354816	548	16	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.1	-0.000264
2354916	549	16	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.1	-0.000257
2355016	550	16	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.9	-0.000213
2149317	493	17	24.0	549.2	1,031.6	823.8	1,023.7	100.0		3.6	-0.000900
2149417	494	17	22.8	517.7	959.6	764.8	981.2	100.0		3.6	-0.000900
2149517	495	17	22.9	519.5	959.6	764.9	987.2	100.0		3.6	0.000900
2149617	496	17	22.7	510.9	948.6	756.5	980.2	100.0		3.6	-0.000900
2149717	497	17	22.6	512.6	942.5	752.0	978.3	100.0		3.6	-0.000900

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	Water Requirements
								(Pounds)			(Gal./Day)
2150417	504	17	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		3.6	-0.000900
2150517	505	17	22.8	517.7	959.6	764.8	981.2	100.0		3.6	-0.000900
2150617	506	17	22.9	982.2	959.6	764.9	987.2	100.0		3.6	-0.000900
2150717	507	17	22.9	982.2	959.6	764.9	987.2	100.0		3.6	-0.000900
2150817	508	17	22.7	510.9	948.6	756.5	980.2	100.0		3.6	-0.000900
2150917	509	17	22.6	512.6	942.5	752.0	978.3	100.0		3.6	-0.000900
2151017	510	17	23.0	521.4	959.4	769.3	994.2	100.0		3.6	-0.000900
2253217	532	17	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000900
2253317	533	17	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000900
2253417	534	17	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000900
2253517	535	17	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000900
2253617	536	17	16.0	371.9	616.8	499.1	700.0	100.0	-22.0	3.6	-0.000900
2354717	547	17	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.5	-0.000382
2354817	548	17	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	1.0	-0.000264
2354917	549	17	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	1.0	-0.000257
2355017	550	17	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.8	-0.000213
2149318	493	18	24.0	549.2	1,031.6	823.8	1,023.7	100.0		2.6	-0.001098
2149418	494	18	22.8	517.7	59.6	764.8	981.2	100.0		2.6	-0.001098
2149518	495	18	22.9	519.5	959.6	764.9	987.2	100.0		2.6	-0.001098
2149618	496	18	22.7	510.9	948.6	756.5	980.2	100.0		2.6	-0.001098
2149718	497	18	22.6	512.6	942.5	752.0	978.3	100.0		2.6	-0.001098
2150418	504	18	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		2.6	-0.001098
2150518	505	18	22.8	517.7	959.6	764.8	981.2	100.0		2.6	-0.001098
2150618	506	18	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001098
2150718	507	18	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001098
2150818	508	18	22.7	510.9	948.6	756.5	980.2	100.0		2.6	-0.001098
2150918	509	18	22.6	512.6	942.5	752.0	978.3	100.0		2.6	-0.001098
2151018	510	18	23.0	521.4	959.4	769.3	994.2	100.0		2.6	-0.001098
2152218	522	18	19.1	436.6	821.2	651.6	819.0	100.0		2.6	-0.001098
2152318	523	18	23.0	521.6	966.2	769.3	990.6	100.0		2.6	-0.001098

Table C.4 (Continued)

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	Water Requirements
								(Pounds)			(Gal./Day)
2152418	524	18	23.2	527.6	972.7	775.0	1,004.8	100.0		2.6	-0.001098
2254118	541	18	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.6	-0.001098
2354718	547	18	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.1	-0.000465
2354818	548	18	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	0.8	-0.000321
2354918	549	18	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	0.7	-0.000313
2355018	550	18	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.6	-0.000260
2355718	557	18	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.5	-0.000201
2152219	522	19	19.1	436.6	821.2	651.6	819.0	100.0		2.6	-0.001270
2150419	504	19	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		2.6	-0.001270
2150519	505	19	22.8	517.7	959.6	764.8	981.2	100.0		2.6	-0.001270
2150619	506	19	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001270
2150719	507	19	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001270
2150819	508	19	22.7	510.9	948.6	756.5	980.2	100.0		2.6	-0.001270
2150919	509	19	22.6	512.6	942.5	752.0	978.3	100.0		2.6	-0.001270
2151019	510	19	23.0	521.4	959.4	769.3	994.2	100.0		2.6	-0.001270
2152319	523	19	23.0	521.6	966.2	769.3	990.6	100.0		2.6	-0.001270
2152419	524	19	23.2	527.6	972.7	775.0	1,004.8	100.0		2.6	-0.001270
2254119	541	19	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.6	-0.001270
2354719	547	19	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.1	-0.000538
2354819	548	19	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	0.8	-0.000372
2354919	549	19	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	0.7	-0.000362
2355019	550	19	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.6	-0.000300
2355719	557	19	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.5	-0.000233
2150420	504	20	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		2.6	-0.001260
2150520	505	20	22.8	517.7	959.6	764.8	981.2	100.0		2.6	-0.001260
2150620	506	20	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001260
2150720	507	20	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001260
2150820	508	20	22.7	510.9	948.6	756.5	980.2	100.0		2.6	-0.001260
2150920	509	20	22.6	512.6	942.5	752.0	978.3	100.0		2.6	-0.001260
2151020	510	20	23.0	521.4	959.4	769.3	994.2	100.0		2.6	-0.001260

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			Water Requirements
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	
								.....(Pounds).....			(Gal./Day)
2152320	523	20	23.0	521.6	966.2	769.3	990.6	100.0		2.6	-0.001260
2152420	524	20	23.2	527.6	972.7	775.0	1,004.8	100.0		2.6	-0.001260
2254120	541	20	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.6	-0.001260
2354720	547	20	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.1	-0.000534
2354820	548	20	39.5	865.1	1,935.4	1,501.0	1,661.8	29.3	100.0	0.8	-0.000369
2354920	549	20	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	0.7	-0.000359
2355020	550	20	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.6	-0.000298
2355720	557	20	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.5	-0.000231
2152221	522	21	19.1	436.6	821.2	651.6	819.0	100.0		2.6	-0.001191
2150421	504	21	33.3	762.4	1,432.2	1,143.7	1,421.3	100.0		2.6	-0.001191
2150521	505	21	22.8	517.7	959.6	764.8	981.2	100.0		2.6	-0.001191
2150621	506	21	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001191
2150721	507	21	22.9	982.2	959.6	764.9	987.2	100.0		2.6	-0.001191
2150821	508	21	22.7	510.9	948.6	756.5	980.2	100.0		2.6	-0.001191
2150921	509	21	22.6	512.6	942.5	752.0	978.3	100.0		2.6	-0.001191
2151021	510	21	23.0	521.4	959.4	769.3	994.2	100.0		2.6	-0.001191
2152321	523	21	23.0	521.6	966.2	769.3	990.6	100.0		2.6	-0.001191
2152421	524	21	23.2	527.6	972.7	775.0	1,004.8	100.0		2.6	-0.001191
2254121	541	21	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.6	-0.001191
2354721	547	21	42.9	939.7	2,071.2	1,611.8	1,805.2	42.4	100.0	1.1	-0.000505
2354921	549	21	39.3	859.6	1,921.2	1,489.5	1,656.4	28.5	100.0	0.7	-0.000340
2355021	550	21	35.2	758.2	1,704.9	1,321.7	1,487.9	23.7	100.0	0.6	-0.000282
2355721	557	21	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.5	-0.000219
2152224	522	24	19.1	436.6	821.2	651.6	819.0	100.0		2.4	-0.001152
2152324	523	24	23.0	521.6	966.2	769.3	990.6	100.0		2.4	-0.001152
2152424	524	24	23.2	527.6	972.7	775.0	1,004.8	100.0		2.4	-0.001152
2254124	541	24	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.4	-0.001152
2355724	557	24	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.4	-0.000211
2152228	522	28	19.1	436.6	821.2	651.6	819.0	100.0		2.7	-0.001080

Table C.4. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:			
			Protein	Meta. Energy	Calcium	Phosphorous	Lysine	Pork	Feeder Pigs	Nitrogen	Water Requirements
								(Pounds)			(Gal./Day)
2152328	523	28	23.0	521.6	966.2	769.3	990.6	100.0		2.7	-0.001080
2152428	524	28	23.2	527.6	972.7	775.0	1,004.8	100.0		2.7	-0.001080
2254128	541	28	15.4	359.2	594.7	481.1	674.3	100.0	-24.7	2.7	-0.001080
2355728	557	28	35.2	758.2	1,704.9	1,321.7	1,487.9	18.4	100.0	0.5	-0.000198

Source: Adapted from the Firm Enterprise Data System (Economic Research service, 1981)

[a] Units of nutrients are:
Protein -- kilograms/cwt.
Metabolizable energy -- megacalories/cwt.
Calcium -- grams/cwt.
Phospherous -- grams/cwt.
Lysine -- grams/cwt.

Table C.5. Nutrient and water requirements and production levels for feeder/yearling/calf production, 1979

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3110203	102	3	107.5	1,410.9	3,510.9	3,192.3	0.0	41.0	31.0	63.0	6.0		4.6	-0.001067
3210303	103	3	132.2	1,713.0	4,224.4	3,862.9	0.0	33.0	24.0	34.0	21.0	21.0	5.3	-0.000859
3110403	104	3	91.7	1,279.1	3,054.7	2,921.0	0.0	29.5	29.5	60.1	10.4		4.1	-0.000768
3110503	105	3	105.0	1,385.2	3,469.2	3,268.1	0.0	25.0	30.0	60.6	9.4		4.5	-0.000650
3210603	106	3	124.6	1,585.6	4,089.4	3,689.8	0.0	59.0	14.3	25.9	19.8	40.0	7.2	-0.001535
3110703	107	3	90.1	1,182.0	2,968.4	2,651.5	0.0	27.0	32.8	57.6	9.6		3.8	-0.000703
3110204	102	4	107.5	1,410.9	3,510.9	3,192.3	0.0	41.0	31.0	63.0	6.0		4.6	-0.001230
3210304	103	4	132.2	1,713.0	4,224.4	3,862.9	0.0	33.0	24.0	34.0	21.0	21.0	5.3	-0.000990
3110404	104	4	91.7	1,279.1	3,054.7	2,921.0	0.0	29.5	29.5	60.1	10.4		4.1	-0.000885
3110504	105	4	105.0	1,385.2	3,469.2	3,268.1	0.0	25.0	30.0	60.6	9.4		4.5	-0.000750
3210604	106	4	124.6	1,585.6	4,089.4	3,689.8	0.0	59.0	14.3	25.9	19.8	40.0	7.2	-0.001770
3110704	107	4	90.1	1,182.0	2,968.4	2,651.5	0.0	27.0	32.8	57.6	9.6		3.8	-0.000810
3110405	104	5	91.7	1,279.1	3,054.7	2,921.0	0.0	29.5	29.5	60.1	10.4		4.1	-0.001239
3110505	105	5	105.0	1,385.2	3,469.2	3,268.1	0.0	25.0	30.0	60.6	9.4		4.5	-0.001050
3210605	106	5	124.6	1,585.6	4,089.4	3,689.8	0.0	59.0	14.3	25.9	19.8	40.0	7.2	-0.002478
3113005	130	5	145.4	1,662.4	3,471.7	3,159.0	0.0	30.6	31.0	57.5	11.5		5.3	-0.001285
3113105	131	5	117.4	1,560.6	3,808.4	3,474.3	0.0	39.8	31.0	59.7	9.3		5.2	-0.001672
3113205	132	5	105.5	1,404.3	3,422.0	3,124.5	0.0	30.4	32.7	56.9	10.4		4.7	-0.001277
3214206	142	6	107.9	1,385.8	3,484.3	3,126.8	0.3	48.3	22.0	36.6	12.8	28.6	13.0	-0.001207
3213707	137	7	93.2	1,212.5	3,099.5	2,791.5	0.7	38.6	16.9	15.5	12.4	55.2	10.8	-0.000695
3213607	136	7	91.6	1,190.1	2,995.3	2,700.9	0.7	30.9	13.4	4.3	22.5	59.8	10.7	-0.000556
3214207	142	7	107.9	1,385.8	3,484.3	3,126.8	0.3	48.3	22.0	36.6	12.8	28.6	13.0	-0.000869
3111008	110	8	79.0	1,041.6	2,704.6	2,372.9	0.0	27.3	32.7	59.1	8.2		10.3	-0.000725
3111308	113	8	93.9	1,204.6	3,114.5	2,828.7	0.0	17.3	26.8	57.9	17.3		13.2	-0.000460
3111408	114	8	85.6	1,123.2	2,871.0	2,541.9	0.0	27.8	31.2	59.6	9.3		11.6	-0.000739
3111508	115	8	95.5	1,275.4	3,181.6	2,896.3	0.0	19.6	32.6	57.5	10.0		14.0	-0.000521
3211608	116	8	103.1	1,332.2	3,288.6	3,048.2	0.0	16.0	16.9	20.5	22.1	40.5	13.6	-0.000425
3213908	139	8	103.0	1,307.4	3,246.9	2,950.3	0.0	37.8	15.5	20.9	17.6	46.0	11.9	-0.001004
3214008	140	8	105.1	1,341.8	3,392.1	3,060.1	0.0	44.5	21.6	37.6	12.7	28.1	12.3	-0.001183

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3214108	141	8	97.2	1,288.5	3,254.9	2,927.5	0.0	45.5	20.7	25.4	14.6	39.4	11.7	-0.001209
3214208	142	8	107.9	1,385.8	3,484.3	3,126.8	0.3	48.3	22.0	36.6	12.8	28.6	13.0	-0.001283
3110409	104	9	91.7	1,279.1	3,054.7	2,921.0	0.0	29.5	29.5	60.1	10.4		4.1	-0.000885
3110509	105	9	105.0	1,385.2	3,469.2	3,268.1	0.0	25.0	30.0	60.6	9.4		4.5	-0.000750
3110709	107	9	90.1	1,182.0	2,968.4	2,651.5	0.0	27.0	32.8	57.6	9.6		3.8	-0.000810
3111909	119	9	96.5	1,288.7	2,992.0	2,668.2	0.0	19.1	32.1	58.0	9.9		4.5	-0.000573
3212009	120	9	122.3	1,632.7	3,700.2	3,449.6	0.0	35.1	7.0	15.4	30.7	46.9	5.4	-0.001053
3111309	113	9	93.9	1,204.6	3,114.5	2,828.7	0.0	17.3	26.8	57.9	17.3		4.1	-0.000519
3111409	114	9	85.6	1,123.2	2,871.0	2,541.9	0.0	27.8	31.2	59.6	9.3		3.6	-0.000834
3111509	115	9	95.5	1,275.4	3,181.6	2,896.3	0.0	19.6	32.6	57.5	10.0		4.4	-0.000588
3211609	116	9	103.1	1,332.2	3,288.6	3,048.2	0.0	16.0	16.9	20.5	22.1	40.5	4.2	-0.000480
3112109	121	9	101.9	1,333.1	3,362.5	3,006.4	0.0	38.0	31.3	63.1	5.6		4.2	-0.001140
3110209	102	9	107.5	1,410.9	3,510.9	3,192.3	0.0	41.0	31.0	63.0	6.0		4.6	-0.001230
3210309	103	9	132.2	1,713.0	4,224.4	3,862.9	0.0	33.0	24.0	34.0	21.0	21.0	5.3	-0.000990
3305110	51	10	146.5	1,880.2	4,506.6	4,231.0	0.2	37.5	18.2	24.2	24.0	33.6	19.1	-0.001294
3305210	52	10	149.2	1,915.0	4,569.4	4,303.1	0.3	40.5	11.3	21.6	27.1	40.0	19.4	-0.001398
3305310	53	10	157.6	1,917.6	5,040.7	4,711.0	0.4	40.7	18.1	48.6	15.3	18.0	22.1	-0.001405
3213310	133	10	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	11.8	-0.001532
3213311	133	11	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	11.8	-0.000799
3213611	136	11	91.6	1,190.1	2,995.3	2,700.9	0.7	30.9	13.4	4.3	22.5	59.8	10.7	-0.000556
3213711	137	11	93.2	1,212.5	3,099.5	2,791.5	0.7	38.6	16.9	15.5	12.4	55.2	10.8	-0.000695
3213312	133	12	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	11.8	-0.000799
3214212	142	12	107.9	1,385.8	3,484.3	3,126.8	0.3	48.3	22.0	36.6	12.8	28.6	13.0	-0.000869
3213913	139	13	103.0	1,307.4	3,246.9	2,950.3	0.0	37.8	15.5	20.9	17.6	46.0	11.9	-0.000998
3214013	140	13	105.1	1,341.8	3,392.1	3,060.1	0.0	44.5	21.6	37.6	12.7	28.1	12.3	-0.001175
3214113	141	13	97.2	1,288.5	3,254.9	2,927.5	0.0	45.5	20.7	25.4	14.6	39.4	11.7	-0.001202
3112413	124	13	130.7	1,728.7	3,979.4	3,606.5	0.0	31.5	32.8	67.2			17.2	-0.000832
3112513	125	13	113.5	1,512.9	3,792.6	3,365.8	0.0	20.5	29.8	60.2	10.0		16.4	-0.000541
3111313	113	13	93.9	1,204.6	3,114.5	2,828.7	0.0	17.3	26.8	57.9	17.3		13.2	-0.000457

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3111413	114	13	85.6	1,123.2	2,871.0	2,541.9	0.0	27.8	31.2	59.6	9.3		11.6	-0.000734
3111513	115	13	95.5	1,275.4	3,181.6	2,896.3	0.0	19.6	32.6	57.5	10.0		14.0	-0.000518
3211613	116	13	103.1	1,332.2	3,288.6	3,048.2	0.0	16.0	16.9	20.5	22.1	40.5	13.6	-0.000423
3112114	121	14	101.9	1,333.1	3,362.5	3,006.4	0.0	38.0	31.3	63.1	5.6		4.2	-0.001319
3111314	113	14	93.9	1,204.6	3,114.5	2,828.7	0.0	17.3	26.8	57.9	17.3		4.1	-0.000601
3111414	114	14	85.6	1,123.2	2,871.0	2,541.9	0.0	27.8	31.2	59.6	9.3		3.6	-0.000965
3111514	115	14	95.5	1,275.4	3,181.6	2,896.3	0.0	19.6	32.6	57.5	10.0		4.4	-0.000680
3211614	116	14	103.1	1,332.2	3,288.6	3,048.2	0.0	16.0	16.9	20.5	22.1	40.5	4.2	-0.000555
3112714	127	14	124.5	1,645.3	4,129.8	3,771.2	0.0	39.5	30.6	62.8	6.6		5.3	-0.001371
3112814	128	14	99.2	1,308.5	3,294.0	2,936.2	0.0	28.1	28.4	58.3	13.3		4.5	-0.000975
3212914	129	14	144.0	1,867.5	4,533.5	4,183.3	0.0	44.2	18.9	34.1	20.7	26.3	5.9	-0.001534
3112414	124	14	130.7	1,728.7	3,979.4	3,606.5	0.0	31.5	32.8	67.2			5.3	-0.001093
3112514	125	14	113.5	1,512.9	3,792.6	3,365.8	0.0	20.5	29.8	60.2	10.0		5.1	-0.000712
3213315	133	15	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	11.8	-0.001248
3213915	139	15	103.0	1,307.4	3,246.9	2,950.3	0.0	37.8	15.5	20.9	17.6	46.0	11.9	-0.001062
3214015	140	15	105.1	1,341.8	3,392.1	3,060.1	0.0	44.5	21.6	37.6	12.7	28.1	12.3	-0.001251
3214115	141	15	97.2	1,288.5	3,254.9	2,927.5	0.0	45.5	20.7	25.4	14.6	39.4	11.7	-0.001279
3305116	51	16	146.5	1,880.2	4,506.6	4,231.0	0.2	37.5	18.2	24.2	24.0	33.6	17.5	-0.001360
3305216	52	16	149.2	1,915.0	4,569.4	4,303.1	0.3	40.5	11.3	21.6	27.1	40.0	17.8	-0.001468
3305316	53	16	157.6	1,917.6	5,040.7	4,711.0	0.4	40.7	18.1	48.6	15.3	18.0	20.2	-0.001476
3306416	64	16	179.3	2,309.8	5,463.1	5,157.2	0.0	60.8	7.6	36.2	20.5	35.6	20.8	-0.002204
3306516	65	16	169.9	2,177.5	5,205.7	4,908.3	0.0	58.0	11.3	29.0	25.3	34.3	19.2	-0.002103
3213316	133	16	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	10.8	-0.001610
3113416	134	16	92.7	1,224.5	3,066.5	2,739.0	0.6	38.8	33.6	59.9	6.5		11.0	-0.001407
3305616	56	16	165.6	2,897.9	5,081.9	4,740.4	0.0	56.5	9.3	34.8	17.1	38.8	19.3	-0.002049
3305716	57	16	157.0	2,000.5	4,760.7	4,470.4	0.2	51.2	8.7	30.7	22.9	37.7	17.6	-0.001856
3306717	67	17	159.8	2,129.7	5,078.3	4,771.6	0.6	50.5	4.3	24.1	26.9	44.8	18.8	-0.002121
3306817	68	17	172.3	2,323.8	5,541.0	5,198.8	0.2	58.9	15.3	42.1	17.3	24.8	21.5	-0.002474
3306417	64	17	179.3	2,309.8	5,463.1	5,157.2	0.0	60.8	7.6	36.2	20.5	35.6	20.8	-0.002554

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3306517	65	17	169.9	2,177.5	5,205.7	4,908.3	0.0	58.0	11.3	29.0	25.3	34.3	19.2	-0.002436
3306718	67	18	159.8	2,129.7	5,078.3	4,771.6	0.6	50.5	4.3	24.1	26.9	44.8	3.1	-0.001950
3306818	68	18	172.3	2,323.8	5,541.0	5,198.8	0.2	58.9	15.3	42.1	17.3	24.8	3.6	-0.002275
3213318	133	18	97.7	1,256.3	3,170.0	2,854.0	0.2	44.4	23.0	38.6	12.3	26.1	1.8	-0.001715
3127218	272	18	175.4	2,369.0	5,558.5	5,110.1	0.0	47.4	24.1	40.7	8.1	27.1	4.2	-0.001831
3227318	273	18	108.6	1,411.7	3,521.7	3,159.9	0.0	40.2	23.5	32.0	10.4	34.1	2.0	-0.001552
3127418	274	18	119.4	1,534.1	3,807.2	3,457.2	0.0	49.8	24.3	29.1	9.2	36.6	2.2	-0.001923
3226318	263	18	111.1	1,337.1	3,577.0	3,237.3	0.1	35.0	19.6	16.2	13.9	50.3	1.6	-0.001352
3226518	265	18	89.1	1,145.4	2,889.9	2,602.6	0.0	23.4	5.7	6.0	34.0	54.3	1.6	-0.000904
3127519	275	19	98.1	1,329.5	3,262.6	2,947.1	0.0	26.9	22.6	48.1	18.1	11.2		-0.001399
3127619	276	19	109.2	1,477.5	3,561.4	3,242.3	0.0	39.5	29.7	47.9	5.9	16.5		-0.002055
3127719	277	19	117.6	1,577.3	3,863.2	3,489.4	0.0	46.6	36.4	63.6				-0.002424
3127819	278	19	125.5	1,511.4	4,031.0	3,697.9	0.0	42.1	20.6	44.1	13.8	21.5		-0.002190
3127919	279	19	143.9	1,749.6	4,576.7	4,206.8	0.0	35.0	31.2	40.2	4.2	24.5		-0.001820
3228019	280	19	122.7	1,528.6	3,852.0	3,604.4	0.0	30.0	26.6	46.6	11.9	14.9		-0.001560
3128119	281	19	150.5	1,832.9	4,752.5	4,429.5	0.0	28.4	35.5	54.9	4.7	4.9		-0.001477
3228319	283	19	130.5	1,598.3	4,202.8	3,853.3	0.0	31.6	36.9	45.2	0.0	17.9		-0.001644
3127219	272	19	175.4	2,369.0	5,558.5	5,110.1	0.0	47.4	24.1	40.7	8.1	27.1		-0.002465
3227319	273	19	108.6	1,411.7	3,521.7	3,159.9	0.0	40.2	23.5	32.0	10.4	34.1		-0.002091
3127419	274	19	119.4	1,534.1	3,807.2	3,457.2	0.0	49.8	24.3	29.1	9.2	36.6		-0.002590
3226319	263	19	111.1	1,337.1	3,577.0	3,237.3	0.1	35.0	19.6	16.2	13.9	50.3		-0.001820
3226519	265	19	89.1	1,145.4	2,889.9	2,602.6	0.0	23.4	5.7	6.0	34.0	54.3		-0.001217
3226320	263	20	111.1	1,337.1	3,577.0	3,237.3	0.1	35.0	19.6	16.2	13.9	50.3		-0.001890
3226520	263	20	89.1	1,145.4	2,889.9	2,602.6	0.0	23.4	5.7	6.0	34.0	54.3		-0.001264
3126620	266	20	138.9	1,670.6	4,533.2	4,104.2	0.0	42.4	27.0	45.4	3.8	23.9		-0.002290
3126820	268	20	117.6	1,425.8	3,763.7	3,450.4	0.0	42.1	7.4	8.8	27.6	56.2		-0.002273
3127820	278	20	125.5	1,511.4	4,031.0	3,697.9	0.0	42.1	20.6	44.1	13.8	21.5		-0.002273
3127920	279	20	143.9	1,749.6	4,576.7	4,206.8	0.0	35.0	31.2	40.2	4.2	24.5		-0.001890
3228020	280	20	122.7	1,528.6	3,852.0	3,604.4	0.0	30.0	26.6	46.6	11.9	14.9		-0.001620

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3126920	269	20	127.5	1,549.0	3,677.6	3,746.2	0.0	47.6	21.2	40.8	13.1	24.9		-0.002570
3127020	270	20	114.2	1,406.9	3,755.1	3,421.1	0.0	26.1	18.2	19.5	21.8	40.4		-0.001409
3327120	271	20	96.4	1,153.4	2,977.1	2,761.8	0.0	34.8		1.6	35.2	64.8		-0.001879
3128120	281	20	150.5	1,832.9	4,752.5	4,429.5	0.0	28.4	35.5	54.9	4.7	4.9		-0.001534
3228320	283	20	130.5	1,598.3	4,202.8	3,853.3	0.0	31.6	36.9	45.2		17.9		-0.001706
3226021	260	21	111.6	1,439.1	3,637.9	3,260.7	0.0	44.3	25.6	35.8	9.0	29.5		-0.002038
3226121	261	21	96.8	1,253.9	3,269.6	2,920.7	0.0	34.0	19.2	31.4	18.1	31.5		-0.001564
3126221	262	21	113.6	1,488.9	3,697.0	3,365.7	0.0	39.1	33.0	67.0				-0.001799
3225721	257	21	150.7	1,816.9	4,618.5	4,323.4	0.0	40.0	24.8	35.4	10.7	29.2		-0.001840
3125821	258	21	118.0	1,459.4	3,817.0	3,479.4	0.0	33.1	21.6	16.8	13.7	48.0		-0.001523
3125921	259	21	109.2	1,437.4	3,559.6	3,221.4	0.1	36.7	21.8	35.6	11.7	30.9		-0.001688
3126621	266	21	138.9	1,670.6	4,533.2	4,104.2	0.0	42.4	27.0	45.4	3.8	23.9		-0.001951
3126821	268	21	117.6	1,425.8	3,763.7	3,450.4	0.0	42.1	7.4	8.8	27.6	56.2		-0.001937
3305122	51	22	146.5	1,880.2	4,506.6	4,231.0	0.2	37.5	18.2	24.2	24.0	33.6	15.8	-0.001575
3305222	52	22	149.2	1,915.0	4,569.4	4,303.1	0.3	40.5	11.3	21.6	27.1	40.0	16.1	-0.001701
3305322	53	22	157.6	1,917.6	5,040.7	4,711.0	0.4	40.7	18.1	48.6	15.3	18.0	18.3	-0.001709
3305922	59	22	151.4	1,940.1	4,653.3	4,369.0	0.0	46.4	8.2	37.4	22.5	31.8	15.8	-0.001949
3306022	60	22	152.5	2,005.7	4,695.0	4,438.5	0.0	56.2	10.2	41.5	16.5	31.8	18.3	-0.002360
3306122	61	22	140.8	1,821.9	4,212.4	4,002.1	0.0	46.2	10.4	15.9	26.8	46.9	15.3	-0.001940
3305622	56	22	165.6	2,897.9	5,081.9	4,740.4	0.0	56.5	9.3	34.8	17.1	38.8	17.5	-0.002373
3305722	57	22	157.0	2,000.5	4,760.7	4,470.4	0.2	51.2	8.7	30.7	22.9	37.7	16.0	-0.002150
3305923	59	23	151.4	1,940.1	4,653.3	4,369.0	0.0	46.4	8.2	37.4	22.5	31.8	13.6	-0.002007
3306023	60	23	152.5	2,005.7	4,695.0	4,438.5	0.0	56.2	10.2	41.5	16.5	31.8	15.8	-0.002431
3306123	61	23	140.8	1,821.9	4,212.4	4,002.1	0.0	46.2	10.4	15.9	26.8	46.9	13.2	-0.001998
3306723	67	23	159.8	2,129.7	5,078.3	4,771.6	0.6	50.5	4.3	24.1	26.9	44.8	14.7	-0.002184
3306823	68	23	172.3	2,323.8	5,541.0	5,198.8	0.2	58.9	15.3	42.1	17.3	24.8	16.8	-0.002547
3305623	56	23	165.6	2,897.9	5,081.9	4,740.4	0.0	56.5	9.3	34.8	17.1	38.8	15.1	-0.002444
3305723	57	23	157.0	2,000.5	4,760.7	4,470.4	0.2	51.2	8.7	30.7	22.9	37.7	13.8	-0.002214
3209424	94	24	136.7	1,816.5	4,390.1	4,048.9	0.0	89.8	12.7	47.3	10.7	29.4	6.0	-0.004888

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
			(Pounds)											(Gal./Day)
3209524	95	24	144.5	1,841.8	4,378.4	4,086.3	0.0	60.6	16.5	35.5	13.9	34.0	5.4	-0.003299
3209624	96	24	133.6	1,742.6	4,109.6	3,857.4	0.0	57.3	1.8	6.0	26.2	66.0	4.5	-0.003119
3305924	59	24	151.4	1,940.1	4,653.3	4,369.0	0.0	46.4	8.2	37.4	22.5	31.8	5.7	-0.002526
3306024	60	24	152.5	2,005.7	4,695.0	4,438.5	0.0	56.2	10.2	41.5	16.5	31.8	6.6	-0.003059
3306124	61	24	140.8	1,821.9	4,212.4	4,002.1	0.0	46.2	10.4	15.9	26.8	46.9	5.5	-0.002515
3225224	252	24	140.3	1,806.4	4,370.2	4,031.7	0.1	33.7	24.5	29.9	9.5	36.1	5.8	-0.001834
3225324	253	24	127.0	1,630.4	4,050.8	3,692.6	0.0	35.2	19.9	22.1	12.7	45.3	5.2	-0.001916
3305125	61	25	146.5	1,880.2	4,506.6	4,231.0	0.2	37.5	18.2	24.2	24.0	33.6	15.8	-0.001575
3305225	62	25	149.2	1,915.0	4,569.4	4,303.1	0.3	40.5	11.3	21.6	27.1	40.0	16.1	-0.001701
3305325	63	25	157.6	1,917.6	5,040.7	4,711.0	0.4	40.7	18.1	48.6	15.3	18.0	18.3	-0.001709
3207925	79	25	112.2	1,433.2	3,540.1	3,237.7	0.0	33.8	15.1	23.9	19.5	41.6	11.1	-0.001420
3208025	80	25	103.2	1,343.0	3,352.7	3,042.2	0.0	39.3	24.4	28.5	11.0	36.2	11.0	-0.001651
3208125	81	25	105.6	1,503.4	3,717.2	3,401.2	0.0	53.7	14.3	28.0	15.9	41.8	11.3	-0.002255
3208225	82	25	104.3	1,313.5	3,275.4	2,998.6	0.0	47.1	6.4	18.4	26.0	49.2	9.6	-0.001978
3208325	83	25	161.7	2,063.4	5,073.7	4,682.0	0.0	63.1	23.8	58.0	7.8	10.4	16.0	-0.002650
3208526	85	26	118.1	1,462.8	3,637.3	3,375.2	0.0	27.5	7.5	3.9	37.6	51.0	10.0	-0.001155
3207926	79	26	112.2	1,433.2	3,540.1	3,237.7	0.0	33.8	15.1	23.9	19.5	41.6	9.5	-0.001420
3208026	80	26	103.2	1,343.0	3,352.7	3,042.2	0.0	39.3	24.4	28.5	11.0	36.2	9.5	-0.001651
3208126	81	26	105.6	1,503.4	3,717.2	3,401.2	0.0	53.7	14.3	28.0	15.9	41.8	9.7	-0.002255
3208226	82	26	104.3	1,313.5	3,275.4	2,998.6	0.0	47.1	6.4	18.4	26.0	49.2	8.3	-0.001978
3208326	83	26	161.7	2,063.4	5,073.7	4,682.0	0.0	63.1	23.8	58.0	7.8	10.4	13.8	-0.002650
3209426	94	26	136.7	1,816.5	4,390.1	4,048.9	0.0	89.8	12.7	47.3	10.7	29.4	14.2	-0.003772
3209526	95	26	144.5	1,841.8	4,378.4	4,086.3	0.0	60.6	16.5	35.5	13.9	34.0	12.8	-0.002545
3209626	96	26	133.6	1,742.6	4,109.6	3,857.4	0.0	57.3	1.8	6.0	26.2	66.0	10.6	-0.002407
3208926	89	26	167.3	1,941.3	4,485.2	4,228.4	0.0	50.2	12.7	21.3	12.4	53.6	14.6	-0.002108
3209026	90	26	167.5	2,245.8	5,006.8	4,776.7	0.0	59.3	17.4	23.0	14.5	45.1	18.4	-0.002491
3208927	89	27	167.3	1,941.3	4,485.2	4,228.4	0.0	50.2	12.7	21.3	12.4	53.6	12.3	-0.003086
3209027	90	27	167.5	2,245.8	5,006.8	4,776.7	0.0	59.3	17.4	23.0	14.5	45.1	15.4	-0.003645
3209427	94	27	136.7	1,816.5	4,390.1	4,048.9	0.0	89.8	12.7	47.3	10.7	29.4	11.9	-0.005520

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3209527	95	27	144.5	1,841.8	4,378.4	4,086.3	0.0	60.6	16.5	35.5	13.9	34.0	10.8	-0.003725
3209627	96	27	133.6	1,742.6	4,109.6	3,857.4	0.0	57.3	1.8	6.0	26.2	66.0	8.9	-0.003522
3207628	76	28	103.7	1,387.5	3,326.1	2,994.6	0.0	53.3	11.9	10.6	16.6	60.9	4.3	-0.003518
3207828	78	28	92.4	1,204.6	3,116.7	2,787.2	0.0	24.3	16.0	5.4	21.1	57.5	3.6	-0.001604
3209128	91	28	129.3	1,672.3	4,042.9	3,762.2	0.0	22.8	18.0	16.5	19.4	46.2	4.9	-0.001505
3209328	93	28	140.2	1,783.8	4,301.5	3,965.9	0.0	67.6	0.0	66.3	33.7	0.0	4.2	-0.004462
3125428	254	28	138.2	1,375.0	4,325.3	3,944.2	0.0	40.6	21.3	17.7	9.1	51.9	4.2	-0.002680
3225528	255	28	122.3	1,506.7	3,791.8	3,498.7	0.0	28.5	2.8	2.4	34.7	60.1	4.1	-0.001881
3225628	256	28	114.9	1,444.0	3,566.6	3,265.1	0.0	29.3	8.3	12.9	30.7	48.1	3.7	-0.001934
3207629	76	29	103.7	1,387.5	3,326.1	2,994.6	0.0	53.3	11.9	10.6	16.6	60.9	9.0	-0.001870
3207729	77	29	133.5	1,161.7	2,953.4	2,675.6	0.0	29.8	15.2	9.3	23.5	52.0	6.7	-0.001045
3207829	78	29	92.4	1,204.6	3,116.7	2,787.2	0.0	24.3	16.0	5.4	21.1	57.5	7.4	-0.000852
3207929	79	29	112.2	1,433.2	3,540.1	3,237.7	0.0	33.8	15.1	23.9	19.5	41.6	8.0	-0.001186
3208029	80	29	103.2	1,343.0	3,352.7	3,042.2	0.0	39.3	24.4	28.5	11.0	36.2	8.0	-0.001379
3208129	81	2929	105.6	1,503.4	3,717.2	3,401.2	0.0	53.7	14.3	28.0	15.9	41.8	8.1	-0.001884
3208229	82	29	104.3	1,313.5	3,275.4	2,998.6	0.0	47.1	6.4	18.4	26.0	49.2	6.9	-0.001652
3208329	83	29	161.7	2,063.4	5,073.7	4,682.0	0.0	63.1	23.8	58.0	7.8	10.4	11.6	-0.002213
3208529	85	29	118.1	1,462.8	3,637.3	3,375.2	0.0	27.5	7.5	3.9	37.6	51.0	8.4	-0.000965
3208929	89	29	167.3	1,941.3	4,485.2	4,228.4	990.0	50.2	12.7	21.3	12.4	53.6	12.3	-0.001761
3209029	90	29	167.5	2,245.8	5,006.8	4,776.7	994.8	59.3	17.4	23.0	14.5	45.1	15.4	-0.002080
3207630	76	30	103.7	1,387.5	3,326.1	2,994.6	675.8	53.3	11.9	10.6	16.6	60.9	9.0	-0.001498
3207730	77	30	133.5	1,161.7	2,953.4	2,675.6	1,702.2	29.8	15.2	9.3	23.5	52.0	6.7	-0.000833
3207830	78	30	92.4	1,204.6	3,116.7	2,787.2	1,459.0	24.3	16.0	5.4	21.1	57.5	7.4	-0.000683
3207930	79	30	112.2	1,433.2	3,540.1	3,237.7	1,488.9	33.8	15.1	23.9	19.5	41.6	8.0	-0.000950
3208030	80	30	103.2	1,343.0	3,352.7	3,042.2	1,348.9	39.3	24.4	28.5	11.0	36.2	8.0	-0.001105
3208130	81	30	105.6	1,503.4	3,717.2	3,401.2	1,023.7	53.7	14.3	28.0	15.9	41.8	8.1	-0.001509
3208230	82	30	104.3	1,313.5	3,275.4	2,998.6	981.2	47.1	6.4	18.4	26.0	49.2	6.9	-0.001324
3208330	83	30	161.7	2,063.4	5,073.7	4,682.0	987.2	63.1	23.8	58.0	7.8	10.4	11.6	-0.001773
3208930	89	30	167.3	1,941.3	4,485.2	4,228.4	980.2	50.2	12.7	21.3	12.4	53.6	12.3	-0.001411

Table C.5. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:a					Production of:						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
3209030	90	30	167.5	2,245.8	5,006.8	4,776.7	978.3	59.3	17.4	23.0	14.5	45.1	15.4	-0.001667
3209130	91	30	129.3	1,672.3	4,042.9	3,762.2	1,421.3	22.8	18.0	16.5	19.4	46.2	10.3	-0.000641
3209230	92	30	107.8	1,413.4	3,435.9	3,126.9	981.2	32.6	26.5	27.9	9.4	36.2	8.7	-0.000916
3209330	93	30	140.2	1,783.8	4,301.5	3,965.9	987.2	67.6		66.3	33.7		8.4	-0.001900
3209131	91	31	129.3	1,672.3	4,042.9	3,762.2	987.2	22.8	18.0	16.5	19.4	46.2	10.3	-0.000847
3209231	92	31	107.8	1,413.4	3,435.9	3,126.9	980.2	32.6	26.5	27.9	9.4	36.2	8.7	-0.001211
3209331	93	31	140.2	1,783.8	4,301.5	3,965.9	978.3	67.6		66.3	33.7		8.4	-0.002512
3207931	79	31	112.2	1,433.2	3,540.1	3,237.7	994.2	33.8	15.1	23.9	19.5	41.6	8.0	-0.001256
3208031	80	31	103.2	1,343.0	3,352.7	3,042.2	700.0	39.3	24.4	28.5	11.0	36.2	7.9	-0.001460
3208131	81	31	105.6	1,503.4	3,717.2	3,401.2	0.0	53.7	14.3	28.0	15.9	41.8	8.1	-0.001995
3208231	82	31	104.3	1,313.5	3,275.4	2,998.6	0.0	47.1	6.4	18.4	26.0	49.2	6.9	-0.001750
3208331	83	31	161.7	2,063.4	5,073.7	4,682.0	0.0	63.1	23.8	58.0	7.8	10.4	11.6	-0.002345

Source: Adapted from the Firm Enterprise Data System (Economics Research Service, 1981

[a] Units of nutrients are:
Protein -- kilograms/cwt.
Net energy -- megacalories/cwt.
Calcium -- grams/cwt.
Phospherous -- grams/cwt.

Table C.6. Nutrient and water requirements and production levels for grain-fed beef production, 1979

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4256106	561	6	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.002499
4256206	562	6	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002499
4456306	563	6	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.002499
4156406	564	6	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.002499
4156506	565	6	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002499
4356606	566	6	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.002499
4256706	567	6	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002499
4456806	568	6	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002499
4156906	569	6	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002499
4357006	570	6	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002499
4257106	571	6	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002499
4157506	575	6	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002499
4357706	577	6	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002499
4257906	579	6	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002499
4458006	580	6	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002499
4256107	561	7	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.001800
4256207	562	7	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456307	563	7	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.001800
4156407	564	7	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.001800
4156507	565	7	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4356607	566	7	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.001800
4256707	567	7	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456807	568	7	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4156907	569	7	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4357007	570	7	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257107	571	7	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4157507	575	7	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4357707	577	7	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257907	579	7	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a] Protein	Net Energy	Calcium	Phosphorous	Silage	Production of:[b] Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4458007	580	7	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4256108	561	8	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.002657
4256208	562	8	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002657
4456308	563	8	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.002657
4156408	564	8	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.002657
4156508	565	8	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002657
4356608	566	8	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.002657
4256708	567	8	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002657
4456808	568	8	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002657
4156908	569	8	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002657
4357008	570	8	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002657
4257108	571	8	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002657
4157508	575	8	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002657
4357708	577	8	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002657
4257908	579	8	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002657
4458008	580	8	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002657
4256110	561	10	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.003451
4256210	562	10	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.003451
4456310	563	10	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.003451
4156410	564	10	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.2	-0.003451
4156510	565	10	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.003451
4356610	566	10	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.003451
4256710	567	10	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.003451
4456810	568	10	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.003451
4156910	569	10	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.003451
4357010	570	10	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003451
4257110	571	10	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.3	-0.003451
4157510	575	10	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.003451
4357710	577	10	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003451

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4257910	579	10	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.003451
4458010	580	10	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.003451
4256111	561	11	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.001800
4256211	562	11	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456311	563	11	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.001800
4156411	564	11	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.001800
4156511	565	11	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4356611	566	11	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.001800
4256711	567	11	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456811	568	11	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4156911	569	11	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4357011	570	11	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257111	571	11	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4157511	575	11	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4357711	577	11	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257911	579	11	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4458011	580	11	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4256112	561	12	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.001800
4256212	562	12	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456312	563	12	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.001800
4156412	564	12	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.001800
4156512	565	12	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4356612	566	12	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.001800
4256712	567	12	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4456812	568	12	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4156912	569	12	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800
4357012	570	12	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257112	571	12	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4157512	575	12	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.001800

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
			(Pounds)											Gal./Day)
4357712	577	12	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.001800
4257912	579	12	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.001800
4458012	580	12	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.001800
4256113	561	13	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.0	-0.002641
4256213	562	13	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.002641
4456313	563	13	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.002641
4156413	564	13	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.2	-0.002641
4156513	565	13	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.002641
4356613	566	13	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.3	-0.002641
4256713	567	13	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.002641
4456813	568	13	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002641
4156913	569	13	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.002641
4357013	570	13	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.002641
4257113	571	13	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.002641
4157513	575	13	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.002641
4357713	577	13	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.002641
4257913	579	13	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.002641
4458013	580	13	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002641
4558514	585	14	16.1	241.7	442.6	397.2	0.0	100.0		-14.2	-37.5		1.2	-0.003471
4558614	586	14	16.1	241.7	442.6	397.2	0.0	100.0		-14.2	-37.5		1.2	-0.003471
4256115	561	15	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.002810
4256215	562	15	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002810
4456315	563	15	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.002810
4156415	564	15	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.002810
4156515	565	15	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002810
4356615	566	15	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.002810
4256715	567	15	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002810
4456815	568	15	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002810
4156915	569	15	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002810

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4357015	570	15	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002810
4257115	571	15	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002810
4157515	575	15	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.002810
4357715	577	15	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.002810
4257915	579	15	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.002810
4458015	580	15	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.002810
4558215	582	15	13.9	217.4	383.2	342.0	0.1	100.0		-18.0	-38.9		0.9	-0.002810
4558315	583	15	13.9	217.4	383.2	342.0	0.0	100.0		-18.0	-38.9		1.1	-0.002810
4558415	584	15	13.9	217.4	383.2	342.0	0.0	100.0		-18.0	-38.9		1.1	-0.002810
4256116	561	16	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.003626
4256216	562	16	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.003626
4456316	563	16	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.003626
4156416	564	16	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.2	-0.003626
4156516	565	16	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.003626
4356616	566	16	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.3	-0.003626
4256716	567	16	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.003626
4456816	568	16	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.003626
4156916	569	16	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.003626
4357016	570	16	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003626
4257116	571	16	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.3	-0.003626
4157516	575	16	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.2	-0.003626
4357716	577	16	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003626
4257916	579	16	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.0	-0.003626
4458016	580	16	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.003626
4256117	561	17	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			2.1	-0.004200
4256217	562	17	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.004200
4456317	563	17	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.3	-0.004200
4156417	564	17	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.3	-0.004200
4156517	565	17	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.004200

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a] Protein	Net Energy	Calcium	Phosphorous	Silage	Production of:[b] Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4356617	566	17	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.4	-0.004200
4256717	567	17	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.004200
4456817	568	17	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.004200
4156917	569	17	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.004200
4357017	570	17	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.004200
4257117	571	17	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.004200
4157517	575	17	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.3	-0.004200
4357717	577	17	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.4	-0.004200
4257917	579	17	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			2.1	-0.004200
4458017	580	17	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.3	-0.004200
4558217	582	17	13.9	217.4	383.2	342.0	0.1	100.0		-18.0	-38.9		0.8	-0.004200
4558317	583	17	13.9	217.4	383.2	342.0	0.0	100.0		-18.0	-38.9		1.1	-0.004200
4558417	584	17	13.9	217.4	383.2	342.0	0.0	100.0		-18.0	-38.9		1.1	-0.004200
4256118	561	18	22.3	294.5	612.5	542.1	0.0	100.0		-39.1			1.9	-0.003862
4256218	562	18	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			1.9	-0.003862
4456318	563	18	15.2	220.2	403.7	367.1	0.0	100.0				-56.5	1.2	-0.003862
4156418	564	18	23.8	344.1	622.3	562.7	0.0	100.0	-37.0				2.1	-0.003862
4156518	565	18	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.1	-0.003862
4356618	566	18	17.1	200.5	428.9	406.0	0.0	100.0			-52.2		1.3	-0.003862
4256718	567	18	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			1.9	-0.003862
4456818	568	18	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.2	-0.003862
4156918	569	18	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.1	-0.003862
4357018	570	18	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003862
4257118	571	18	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			1.9	-0.003862
4157518	575	18	23.8	344.1	622.3	562.7	0.2	100.0	-37.0				2.1	-0.003862
4357718	577	18	17.1	200.5	428.9	406.0	0.1	100.0			-52.2		1.3	-0.003862
4257918	579	18	22.3	294.5	612.5	542.1	0.2	100.0		-39.1			1.9	-0.003862
4458018	580	18	15.2	220.2	403.7	367.1	0.1	100.0				-56.5	1.2	-0.003862
4558218	582	18	13.9	217.4	383.2	342.0	0.1	100.0		-18.0	-38.9		0.8	-0.003862

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4558318	583	18	13.9	217.4	383.2	342.0	0.0	100.0	16.5	-18.0	-38.9		1.0	-0.003862
4558418	584	18	13.9	217.4	383.2	342.0	0.0	100.0	1.8	-18.0	-38.9		1.0	-0.003862
4558518	585	18	16.1	241.7	442.6	397.2	0.0	100.0	11.9	-14.2	-37.5		1.2	-0.003862
4558618	586	18	16.1	241.7	442.6	397.2	0.0	100.0	16.0	-14.2	-37.5		1.2	-0.003862
4558519	585	19	16.1	241.7	442.6	397.2	0.0	100.0	18.0	-14.2	-37.5		2.1	-0.005201
4558619	586	19	16.1	241.7	442.6	397.2	0.0	100.0	0.0	-14.2	-37.5		1.2	-0.005201
4558520	585	20	16.1	241.7	442.6	397.2	0.0	100.0	21.3	-14.2	-37.5		2.1	-0.005400
4558620	586	20	16.1	241.7	442.6	397.2	0.0	100.0	2.8	-14.2	-37.5		1.1	-0.005400
4558521	585	21	16.1	241.7	442.6	397.2	0.0	100.0	8.3	-14.2	-37.5		1.2	-0.004600
4558621	586	21	16.1	241.7	442.6	397.2	0.0	100.0	11.9	-14.2	-37.5		1.2	-0.004600
4558223	582	23	13.9	217.4	383.2	342.0	0.1	100.0	15.2	-18.0	-38.9		0.8	-0.004325
4558323	583	23	13.9	217.4	383.2	342.0	0.0	100.0	16.0	-18.0	-38.9		1.1	-0.004325
4558423	584	23	13.9	217.4	383.2	342.0	0.0	100.0	15.1	-18.0	-38.9		1.1	-0.004325
4558723	587	23	15.6	240.9	442.7	394.0	0.0	100.0	24.4	-5.3	-46.8		1.2	-0.004325
4558823	588	23	15.6	240.9	442.7	394.0	0.0	100.0	14.3	-5.3	-46.8		1.2	-0.004325
4558524	585	24	16.1	241.7	442.6	397.2	0.0	100.0	6.4	-14.2	-37.5		1.3	-0.005443
4558624	586	24	16.1	241.7	442.6	397.2	0.0	100.0	23.8	-14.2	-37.5		1.3	-0.005443
4558224	582	24	13.9	217.4	383.2	342.0	0.1	100.0	7.5	-18.0	-38.9		0.8	-0.005443
4558324	583	24	13.9	217.4	383.2	342.0	0.0	100.0	12.7	-18.0	-38.9		1.1	-0.005443
4558424	584	24	13.9	217.4	383.2	342.0	0.0	100.0	17.4	-18.0	-38.9		1.1	-0.005443
4558724	587	24	15.6	240.9	442.7	394.0	0.0	100.0	11.9	-5.3	-46.8		1.2	-0.005443
4558824	588	24	15.6	240.9	442.7	394.0	0.0	100.0	15.2	-5.3	-46.8		1.2	-0.005443
4558227	582	27	13.9	217.4	383.2	342.0	0.1	100.0	16.0	-18.0	-38.9		0.8	-0.006147
4558327	583	27	13.9	217.4	383.2	342.0	0.0	100.0	15.1	-18.0	-38.9		1.1	-0.006147
4558427	584	27	13.9	217.4	383.2	342.0	0.0	100.0	24.4	-18.0	-38.9		1.1	-0.006147
4558727	587	27	15.6	240.9	442.7	394.0	0.0	100.0	14.3	-5.3	-46.8		1.2	-0.006147
4558827	588	27	15.6	240.9	442.7	394.0	0.0	100.0	6.4	-5.3	-46.8		1.2	-0.006147
4558228	582	28	13.9	217.4	383.2	342.0	0.1	100.0	23.8	-18.0	-38.9		0.8	-0.006600
4558328	583	28	13.9	217.4	383.2	342.0	0.0	100.0	12.7	-18.0	-38.9		1.1	-0.006600

Table C.6. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]						
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Heifer Yearlings	Steer Yearlings	Nitrogen	Water Requirements
								(Pounds)						(Gal./Day)
4558428	584	28	13.9	217.4	383.2	342.0	0.0	100.0	17.4	-18.0	-38.9		1.1	-0.006600
4558728	587	28	15.6	240.9	442.7	394.0	0.0	100.0	18.0	-5.3	-46.8		1.2	-0.006600
4558828	588	28	15.6	240.9	442.7	394.0	0.0	100.0	26.5	-5.3	-46.8		1.2	-0.006600
4558230	582	30	13.9	217.4	383.2	342.0	0.1	100.0		-18.0	-38.9		0.8	-0.002810
4558330	583	30	13.9	217.4	383.2	342.0	0.0	100.0	18.0	-18.0	-38.9		1.1	-0.002810
4558430	584	30	13.9	217.4	383.2	342.0	0.0	100.0	26.5	-18.0	-38.9		1.1	-0.002810
4558730	587	30	15.6	240.9	442.7	394.0	0.0	100.0		-5.3	-46.8		1.2	-0.002810
4558830	588	30	15.6	240.9	442.7	394.0	0.0	100.0	15.1	-5.3	-46.8		1.2	-0.002810
4558231	582	31	13.9	217.4	383.2	342.0	0.1	100.0	24.4	-18.0	-38.9		0.8	-0.003716
4558331	583	31	13.9	217.4	383.2	342.0	0.0	100.0	14.3	-18.0	-38.9		1.1	-0.003716
4558431	584	31	13.9	217.4	383.2	342.0	0.0	100.0	6.4	-18.0	-38.9		1.1	-0.003716
4558731	587	31	15.6	240.9	442.7	394.0	0.0	100.0		-5.3	-46.8		1.2	-0.003716
4558831	588	31	15.6	240.9	442.7	394.0	0.0	100.0		-5.3	-46.8		1.2	-0.003716

Source: Adapted from data in the Firm Enterprise Data System (Economic Research Service, 1981)

[a] Units of nutrients are:
Protein -- kilograms/cwt.
Net energy -- megacalories/cwt.
Calcium -- grams/cwt.
Phospherous -- grams/cwt.

[b] Negative values indicate input requirements of livestock

Table C.7. Nutrient and water requirements and production levels for roughage-fed beef production, 1979

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a] Protein	Net Energy	Calcium	Phosphorous	Silage	Production of:[b] Beef	Heifer Calves	Steer Calves	Nitrogen	Water Requirements
								(Pounds)				(Gal./Day)
5260003	600	3	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.6	-0.002602
5260103	601	3	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.6	-0.002602
5160203	602	3	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.0	-0.002602
5160303	603	3	27.0	347.7	701.1	641.3	0.0	100.0	-37.0		3.0	-0.002602
5260004	600	4	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.6	-0.003000
5260104	601	4	32.5	413.4	713.4	698.3	0.0	100.0		-39.1	2.6	-0.003000
5160204	602	4	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.0	-0.003000
5160304	603	4	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.0	-0.003000
5260404	604	4	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.6	-0.003000
5260504	605	4	32.5	413.4	713.4	698.3	0.1	100.0		-39.1	2.6	-0.003000
5160604	606	4	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.0	-0.003000
5160704	607	4	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.0	-0.003000
5260405	604	5	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.6	-0.004200
5260905	609	5	29.8	380.6	707.3	670.0	0.2	100.0		-39.1	2.6	-0.004200
5360805	608	5	32.5	413.4	713.4	698.3	0.1	100.0	-18.0	-20.1	2.8	-0.004200
5160605	606	5	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.0	-0.004200
5161005	610	5	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.0	-0.004200
5261108	611	8	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.8	-0.002657
5261208	612	8	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.7	-0.002657
5261308	613	8	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.8	-0.002657
5261408	614	8	32.5	413.4	713.4	698.3	0.0	100.0		-39.1	2.8	-0.002657
5161508	615	8	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.2	-0.002657
5161608	616	8	32.5	413.4	713.4	698.3	0.1	100.0	-37.0		3.2	-0.002657
5161708	617	8	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.2	-0.002657
5161808	618	8	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.2	-0.002657
5260409	604	9	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.8	-0.003000
5260509	605	9	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.8	-0.003000
5160609	606	9	32.5	413.4	713.4	698.3	0.1	100.0	-37.0		3.1	-0.003000
5160709	607	9	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.1	-0.003000
5261209	612	9	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.8	-0.003000

Table C.7. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]				
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Nitrogen	Water Requirements
								(Pounds)				(Gal./Day)
5261309	613	9	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.8	-0.003000
5261409	614	9	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.8	-0.003000
5161609	616	9	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.1	-0.003000
5161709	617	9	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.1	-0.003000
5161809	618	9	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.1	-0.003000
5261910	619	10	32.5	413.4	713.4	698.3	0.0	100.0		-39.1	2.8	-0.003451
5162010	620	10	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.1	-0.003451
5261911	619	11	32.5	413.4	713.4	698.3	0.1	100.0		-39.1	2.9	-0.001800
5162011	620	11	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.2	-0.001800
5261912	619	12	32.5	413.4	713.4	698.3	0.1	100.0		-39.1	2.8	-0.001800
5162012	620	12	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.2	-0.001800
5261213	612	13	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.7	-0.002641
5261313	613	13	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.7	-0.002641
5261413	614	13	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.7	-0.002641
5161613	616	13	32.5	413.4	713.4	698.3	0.1	100.0	-37.0		3.0	-0.002641
5161713	617	13	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.0	-0.002641
5161813	618	13	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.0	-0.002641
5261214	612	14	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.6	-0.003471
5261314	613	14	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.6	-0.003471
5261414	614	14	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.6	-0.003471
5161614	616	14	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.0	-0.003471
5161714	617	14	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.0	-0.003471
5161814	618	14	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.0	-0.003471
5263014	630	14	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.6	-0.003471
5262114	621	14	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.6	-0.003471
5262514	625	14	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.6	-0.003471
5163114	631	14	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		3.0	-0.003471
5162614	626	14	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.0	-0.003471
5261916	619	16	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.8	-0.003626

Table C.7. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a]					Production of:[b]				
			Protein	Net Energy	Calcium	Phosphorous	Silage	Beef	Heifer Calves	Steer Calves	Nitrogen	Water Requirements
								(Pounds)				(Gal./Day)
5162016	620	16	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.1	-0.003626
5262118	621	18	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.6	-0.003862
5262218	622	18	29.8	380.6	707.3	670.0	0.2	100.0		-39.1	2.6	-0.003862
5362318	623	18	27.0	347.7	701.1	641.3	0.0	100.0	-18.0	-20.1	2.7	-0.003862
5262418	624	18	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.7	-0.003862
5262518	625	18	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.7	-0.003862
5162618	626	18	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		2.9	-0.003862
5162718	627	18	32.5	413.4	713.4	698.3	0.2	100.0	-37.0		2.9	-0.003862
5162818	628	18	32.5	413.4	713.4	698.3	0.1	100.0	-37.0		2.9	-0.003862
5162918	629	18	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		2.9	-0.003862
5262119	621	19	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.5	-0.005201
5262519	625	19	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.5	-0.005201
5162619	626	19	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		2.8	-0.005201
5263019	630	19	32.5	413.4	713.4	698.3	0.1	100.0		-39.1	2.5	-0.005201
5163119	631	19	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		2.8	-0.005201
5263219	632	19	27.0	347.7	701.1	641.3	0.1	100.0		-39.1	2.5	-0.005201
5263319	633	19	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.5	-0.005201
5263519	635	19	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.5	-0.005201
5163619	636	19	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		2.8	-0.005201
5163719	637	19	27.0	347.7	701.1	641.3	0.0	100.0	-37.0		2.8	-0.005201
5263220	632	20	27.0	347.7	701.1	641.3	0.2	100.0		-39.1	2.5	-0.005400
5263320	633	20	27.0	347.7	701.1	641.3	0.0	100.0		-39.1	2.5	-0.005400
5263520	635	20	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.5	-0.005400
5163620	636	20	32.5	413.4	713.4	698.3	0.1	100.0	-37.0		2.8	-0.005400
5163720	637	20	29.8	380.6	707.3	670.0	0.2	100.0	-37.0		2.8	-0.005400
5363821	638	21	27.0	347.7	701.1	641.3	0.1	100.0	-18.0	-20.1	2.8	-0.004600
5263921	639	21	29.8	380.6	707.3	670.0	0.2	100.0		-39.1	2.6	-0.004600
5364021	640	21	32.5	413.4	713.4	698.3	0.2	100.0	-18.0	-20.1	2.8	-0.004600
5164121	641	21	27.0	347.7	701.1	641.3	0.1	100.0	-37.0		3.0	-0.004600

Table C.7. Continued

Activity Identification Code	Budget File Number	Livestock Producing Region	Nutrient Requirements:[a] Protein	Net Energy	Calcium	Phosphorous	Silage	Production of:[b] Beef	Heifer Calves	Steer Calves	Nitrogen	Water Requirements
								(Pounds)				(Gal./Day)
5263924	639	24	29.8	380.6	707.3	670.0	0.2	100.0		-39.1	2.8	-0.005443
5364024	640	24	32.5	413.4	713.4	698.3	0.1	100.0	-18.0	-20.1	2.9	-0.005443
5164124	641	24	27.0	347.7	701.1	641.3	0.0	100.0	-37.0		3.1	-0.005443
5264224	642	24	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.8	-0.005443
5164324	643	24	29.8	380.6	707.3	670.0	0.0	100.0	-37.0		3.1	-0.005443
5364028	640	28	27.0	347.7	701.1	641.3	0.0	100.0	-18.0	-20.1	2.9	-0.006600
5264228	642	28	32.5	413.4	713.4	698.3	0.2	100.0		-39.1	2.8	-0.006600
5164328	643	28	32.5	413.4	713.4	698.3	0.0	100.0	-37.0		3.1	-0.006600
5164331	643	31	27.0	347.7	701.1	641.3	0.2	100.0	-37.0		3.1	-0.003716
5264231	642	31	0.0	0.0	0.0	0.0	0.0	100.0		-39.1	2.8	-0.003716

Source: Adapted from data in the Firm Enterprise Data System (Economic Research Service, 1981)

a Units of nutrients are:
Protein -- kilograms/cwt.
Net energy -- megacalories/cwt.
Calcium -- grams/cwt.
Phospherous -- grams/cwt.

b Negative values indicate input requirements of livestock

APPENDIX D

FEED TRANSFER COEFFICIENT DEVELOPMENT

Table D.1 Nutrient Values Available (per unit) from fixed Feed Transfer Activities

Activity Type	Feed Type	Crude Protein	Metabolizable Energy	Net Energy	Calcium	Phos	Lysine
		(kilograms)	(mcals)	(mcals)	(grams)	(grams)	(grams)
DAIRY	BARLEY	2.422	0.000	37.012	15.502	91.000	0.000
DAIRY	CORN	2.261	0.000	45.893	6.782	79.125	0.000
DAIRY	CORN SILAGE	25.402	0.000	504.857	857.304	635.040	0.000
DAIRY	LEGUME HAY	119.750	0.000	958.003	10218.701	1596.672	0.000
DAIRY	NON-LEGUME HAY	78.319	0.000	1086.771	2957.546	1678.604	0.000
DAIRY	OATS	1.602	0.000	22.478	14.210	62.006	0.000
DAIRY	SORGHUM	2.615	0.000	41.130	6.706	73.765	0.000
DAIRY	SORGHUM SILAGE	19.470	0.000	323.598	841.882	480.090	0.000
DAIRY	SOYBEANS	9.858	0.000	35.397	68.967	142.729	0.000
DAIRY	WHEAT	3.488	0.000	49.171	14.549	138.219	0.000
PORK	BARLEY	2.422	62.880	0.000	15.502	91.000	80.559
PORK	CORN	2.261	84.460	0.000	6.782	79.125	60.964
PORK	CORN SILAGE	0.000	0.000	0.000	0.000	0.000	0.000
PORK	LEGUME HAY	0.000	0.000	0.000	0.000	0.000	0.000
PORK	NON-LEGUME HAY	0.000	0.000	0.000	0.000	0.000	0.000
PORK	SORGHUM SILAGE	0.000	0.000	0.000	0.000	0.000	0.000
PORK	SOYBEANS	9.858	66.072	0.000	68.967	142.729	626.509
PORK	WHEAT	3.488	87.636	0.000	14.549	138.219	108.864
BEEF	BARLEY	2.422	0.000	66.912	15.502	91.000	0.000
BEEF	CORN	2.261	0.000	85.004	4.521	79.125	0.000
BEEF	CORN SILAGE	25.402	0.000	809.676	857.304	635.040	0.000
BEEF	LEGUME HAY	119.750	0.000	1213.140	10218.701	1596.672	0.000
BEEF	NON-LEGUME HAY	78.319	0.000	1238.000	2957.546	1678.604	0.000
BEEF	OATS	1.602	0.000	37.076	14.210	62.006	0.000
BEEF	SORGHUM	2.615	0.000	69.294	6.706	73.765	0.000
BEEF	SORGHUM SILAGE	19.470	0.000	477.420	841.882	480.090	0.000
BEEF	SOYBEANS	9.858	0.000	61.279	68.967	142.729	0.000
BEEF	WHEAT	3.488	0.000	86.813	14.549	108.999	0.000

NOTE: These values were developed based on data contained in the NRC Guides to Animal Nutrient Requirements.

Table D.2. Example of feed transfer nutrient coefficient development: Feeding sorghum silage to beef

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1 ton sorghum silage = 2000 pounds

Nutrient Requirments (NRC) values:

DM%	=	29.4	
Prot %	=	7.3	Ck = 0.4536
NEm	=	1.22 Mcal/gram	Ck = 0.4536
NEg	=	0.57 Mcal/gram	Ck = 0.4536
C %	=	0.18	Ck = 4536

Crude Protein Coefficient = (2000) * (0.294) * (0.73) * (0.4536)
= 19.47 kilograms per ton

NE coefficient = (2000) * (0.294) * [(1.22 + 0.57)] * (0.4536)
= 477.42 Mcals per ton

Calcium coefficient = (2000) * (0.294) * (0.0018) * (4536)
= 480.09 grams per ton

Table D.3 Variable coefficients for the nutrient values available per ton of beef pasture transfer activities

Market Region	Protein	Net Energy	Calcium	Phos-phorus
	(kilograms)	(mcals)	(grams)	(grams)
1	43.324	283.727	1980.743	980.233
2	42.477	272.719	2040.232	931.486
3	42.946	275.959	1725.157	933.917
4	43.833	277.942	1575.146	900.850
5	32.878	240.258	1508.780	615.530
6	42.749	281.006	1999.443	989.135
7	46.941	287.613	2455.234	978.814
8	43.893	274.953	1965.420	950.684
9	40.643	267.613	1696.358	779.533
10	42.641	306.740	2084.165	1022.260
11	42.641	306.740	2084.165	1022.260
12	47.069	290.016	2464.269	1014.062
13	42.721	273.063	1830.680	883.226
14	40.683	272.116	1691.760	782.898
15	46.091	297.133	2174.458	999.642
16	42.641	306.740	2084.165	1022.260
17	40.970	433.577	2729.810	825.953
18	41.901	339.181	1803.308	839.948
19	39.159	275.635	1877.860	668.486
20	35.525	298.327	1862.590	642.810
21	44.074	375.239	2259.630	746.840
22	41.673	435.640	3645.140	895.650
23	38.553	458.479	2939.550	852.350
24	49.935	444.371	3211.901	899.703
25	40.802	391.360	2978.000	1047.390
26	48.339	314.026	2657.490	1078.190
27	27.081	203.446	1168.945	630.087
28	37.838	310.164	3687.470	786.725
29	40.722	352.097	2079.951	953.002
30	43.426	289.955	2494.797	780.253
31	44.833	312.243	3469.450	834.160

Table D.4. Variable coefficients for the nutrient values available per ton to dairy pasture transfer activities

Market Region	Protein (kilograms)	Net Energy (mcals)	Calcium (grams)	Phos-phorus (grams)
1	41.828	337.136	1985.711	903.463
2	43.913	350.260	2009.005	984.248
3	42.925	317.026	1638.904	938.712
4	40.440	312.291	1399.449	887.991
5	30.261	283.093	1425.650	615.033
6	42.837	343.649	2003.713	996.190
7	45.653	369.045	2570.758	966.550
8	41.591	329.015	1827.502	1023.832
9	39.539	286.093	1575.707	729.273
10	39.801	398.998	2223.010	984.930
11	39.704	399.242	2216.845	984.750
12	45.429	374.799	2560.320	1016.823
13	39.216	315.040	2076.438	932.382
14	39.542	297.791	1472.992	766.076
15	44.272	375.378	2427.194	1011.048
16	39.801	398.998	2223.010	984.930
17	35.940	288.044	2158.910	805.610
18	36.016	293.345	2054.544	824.446
19	44.447	313.765	1403.130	747.590
20	44.447	313.765	1403.130	747.590
21	0.000	0.000	0.000	0.000
22	45.607	299.209	3981.060	779.830
23	45.788	340.344	2951.030	969.397
24	42.859	352.404	1890.670	1098.100
25	45.607	299.209	3981.060	779.830
26	44.376	344.086	2589.470	963.685
27	43.656	314.536	2359.457	949.850
28	43.067	342.679	1877.316	1054.024
29	44.251	302.124	2103.962	879.596
30	52.910	384.268	3625.633	1046.705
31	53.909	391.007	3758.660	1057.730

Table D.5. Objective function values (rental cost) for private pasture transfer activities

Market Region	Dairy Cost	Beef Cost
	$/ton	
1	22.13	21.47
2	20.80	20.29
3	13.99	14.43
4	15.22	15.16
5	5.00	5.50
6	16.16	16.95
7	14.39	15.37
8	20.10	20.30
9	13.60	12.49
10	16.22	14.47
11	13.71	15.37
12	16.74	21.07
13	18.32	16.40
14	8.88	8.76
15	15.27	15.86
16	8.13	8.48
17	9.49	9.27
18	9.45	8.13
19	4.27	3.72
20	3.59	3.60
21	8.96	5.52
22	23.90	24.62
23	23.02	21.52
24	10.96	13.99
25	22.30	25.01
26	19.71	18.86
27	19.37	17.28
28	10.37	10.26
29	12.93	13.76
30	26.81	24.99
31	27.75	27.75

Table D.6. Objective function values (costs) for silage transfer activities

Market Region	Dairy Cost	Feeder Beef Cost	Roughage-fed Beef Cost
	($/ton)		
1	3.96	0.00	0.00
2	4.41	0.00	0.00
3	3.51	5.59	0.00
4	3.51	5.59	0.00
5	3.74	5.83	0.00
6	3.51	5.59	0.00
7	4.15	8.86	3.67
8	4.41	7.38	3.67
9	4.41	5.10	3.67
10	4.41	5.59	3.67
11	0.00	5.30	0.00
12	4.41	7.08	3.67
13	4.41	6.41	3.67
14	4.41	6.19	3.67
15	4.41	6.64	3.67
16	4.41	5.30	0.00
17	4.41	5.59	3.59
18	4.41	6.11	3.54
19	4.41	5.79	3.27
20	4.41	4.73	3.27
21	0.00	5.30	3.27
22	4.41	4.94	3.27
23	4.41	4.53	3.27
24	3.51	4.94	3.27
25	0.00	5.74	3.27
26	0.00	3.62	3.27
27	3.51	4.85	3.27
28	3.51	4.40	3.27
29	3.51	4.40	3.27
30	3.51	4.40	3.27
31	3.51	4.40	3.27

Table D.7. Pasture/range rental values

State Name	Unit	Rental Value	Adjustment Factor
		(dollars/unit)	
Alabama	ACRE	16.10	
Arizona	AUM	3.90	0.876
Arkansas	ACRE	15.30	
California	AUM	11.10	1.168
Colorado	AUM	9.40	1.122
Florida	ACRE	8.00 *	
Georgia	ACRE	19.80	
Idaho	AUM	8.02	0.990
Illinois	ACRE	34.40	
Indiana	ACRE	32.30	
Iowa	ACRE	36.20	
Kansas	ACRE	12.40	
Kentucky	ACRE	24.10	
Louisiana	ACRE	25.00 *	
Michigan	ACRE	18.00 *	
Minnesota	ACRE	24.20	
Mississippi	ACRE	13.70	
Missouri	ACRE	26.50	
Montana	AUM	10.20	1.089
Nebraska	ACRE	10.20	
Nevada	AUM	5.60	0.914
New Mexico	AUM	4.20	0.698
North Carolina	ACRE	15.50	
North Dakota	ACRE	8.70	
Ohio	ACRE	27.80	
Oklahoma	ACRE	11.00	
Oregon	AUM	6.10	0.930
Pennsylvania	ACRE	15.50	
South Carolina	ACRE	15.20	
South Dakota	ACRE	9.50	
Tennessee	ACRE	22.50	
Texas	ACRE	6.40	
Utah	ACRE	8.20	
Vermont	ACRE	13.30	
Virginia	ACRE	17.70	
Washington	AUM	4.80	0.844
West Virginia	ACRE	5.00 *	
Wisconsin	ACRE	21.10	
Wyoming	AUM	8.65	0.983

Source: (Statistical Reporting Service, 1980)

The adjustment factor is used to convert $/head to AUM
Data with * indicate agricultural extension personnel were contacted

Table D.8. Pasture/range yields used in determining the value of an acre of pasture/range

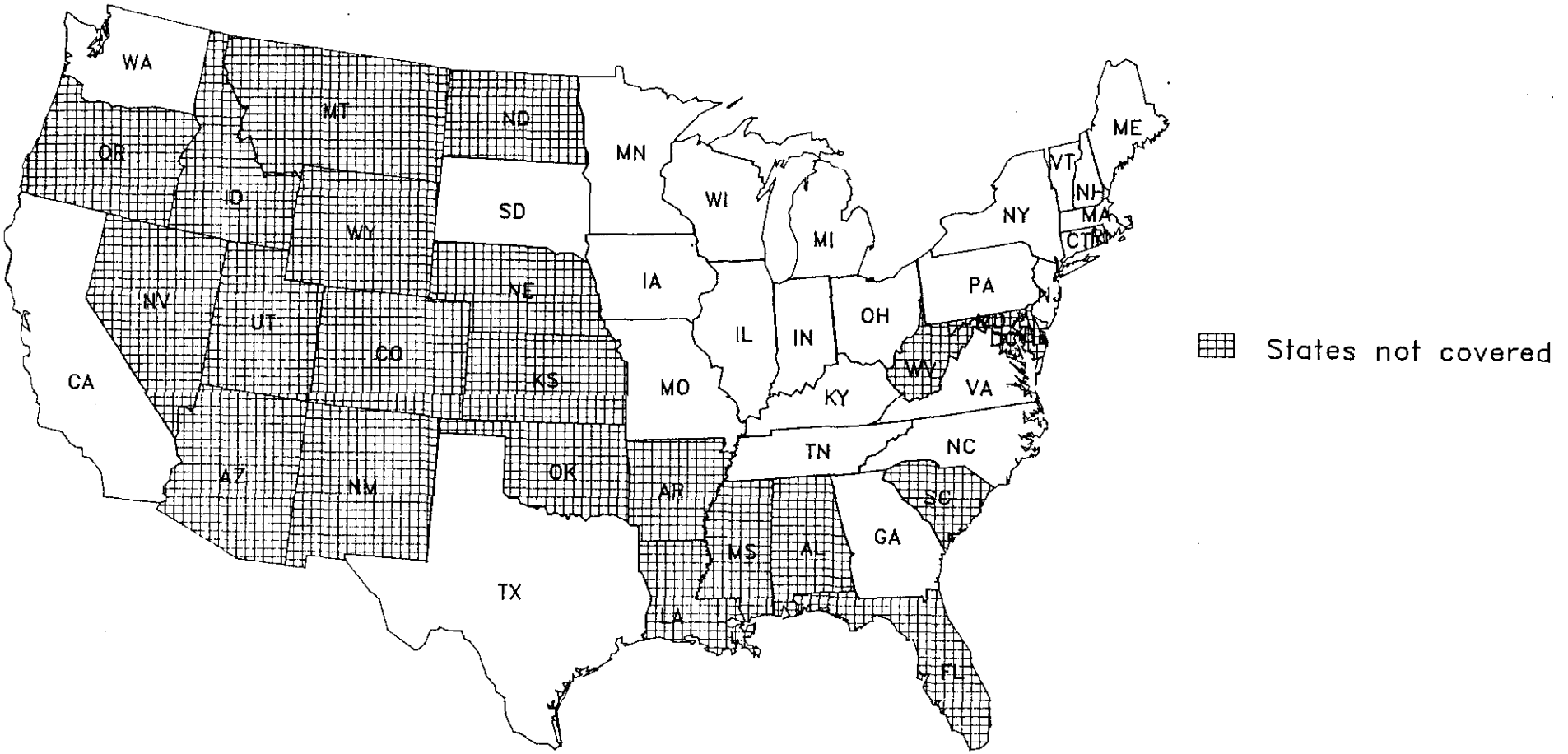
Crop Producing Area	Pasture/ Range Yield	Crop Producing Area	Pasture/ Range Yield
	(Tons/acre)		(Tons/acre)
1	1.34	54	0.97
2	1.13	55	1.15
3	1.47	56	1.28
4	1.40	57	1.53
5	1.42	58	1.28
6	1.50	59	1.37
7	1.24	60	1.34
8	1.47	61	1.14
9	1.23	62	1.06
10	1.28	63	1.44
11	1.17	64	1.28
12	1.07	65	1.38
13	1.15	66	1.61
14	1.18	67	1.86
15	1.26	68	1.73
16	1.31	69	2.36
17	2.32	70	1.80
20	1.51	71	1.31
19	1.39	72	1.76
20	1.37	73	1.99
21	1.48	74	1.65
22	1.16	75	1.94
23	1.71	76	2.11
24	1.75	77	1.10
25	1.47	78	1.33
26	1.46	79	2.07
27	1.58	80	1.23
28	1.66	81	2.25
29	1.55	82	1.41
30	1.28	83	1.33
31	1.18	84	1.43
32	1.32	85	1.17
33	1.03	86	1.69
34	1.24	87	1.89
35	1.37	88	1.50
36	1.25	89	1.66
37	1.22	90	1.46
38	1.33	91	1.50
39	1.36	92	1.50
40	1.46	93	1.68
41	1.89	94	1.55
42	1.46	95	1.67
43	1.21	96	1.88
44	1.38	97	2.02
45	1.51	98	1.17
46	1.56	99	1.89
47	1.16	100	1.61
48	1.20	101	1.67
49	1.32	102	1.95
50	1.12	103	1.84
51	1.26	104	1.73
52	1.04	105	0.89
53	1.79		

APPENDIX E

MAPS REPRESENTING THE REGIONS OF THE U.S. COVERED BY FEDS BUDGETS BY LIVESTOCK ACTIVITY TYPE USED IN AGRICULTURAL RESOURCE INTERREGIONAL MODELLING

Figure E.1. Dairy producing areas

(Shaded areas were not surveyed)



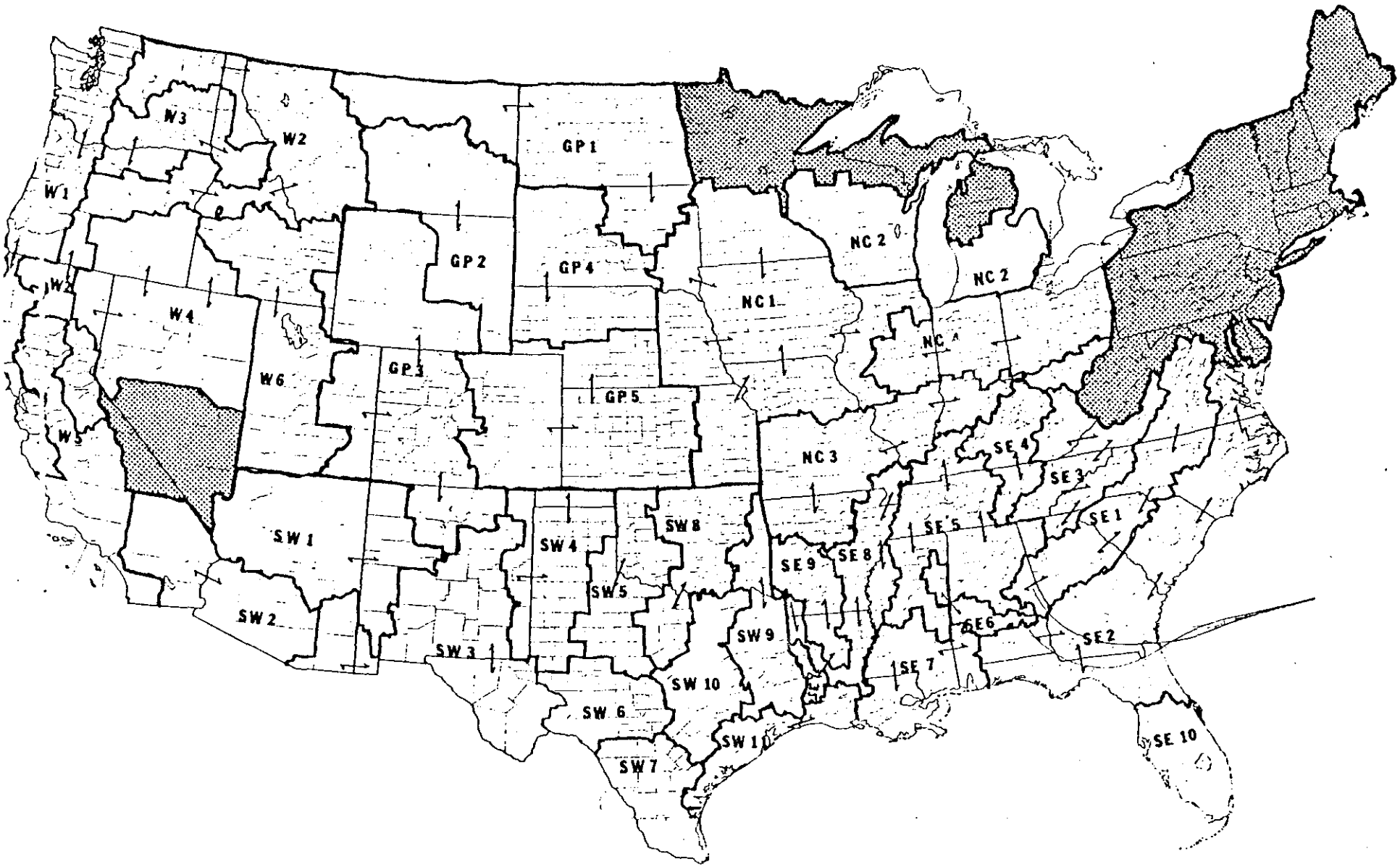


Figure E.2. Grain-fed beef producing regions (shaded areas were excluded from the survey).

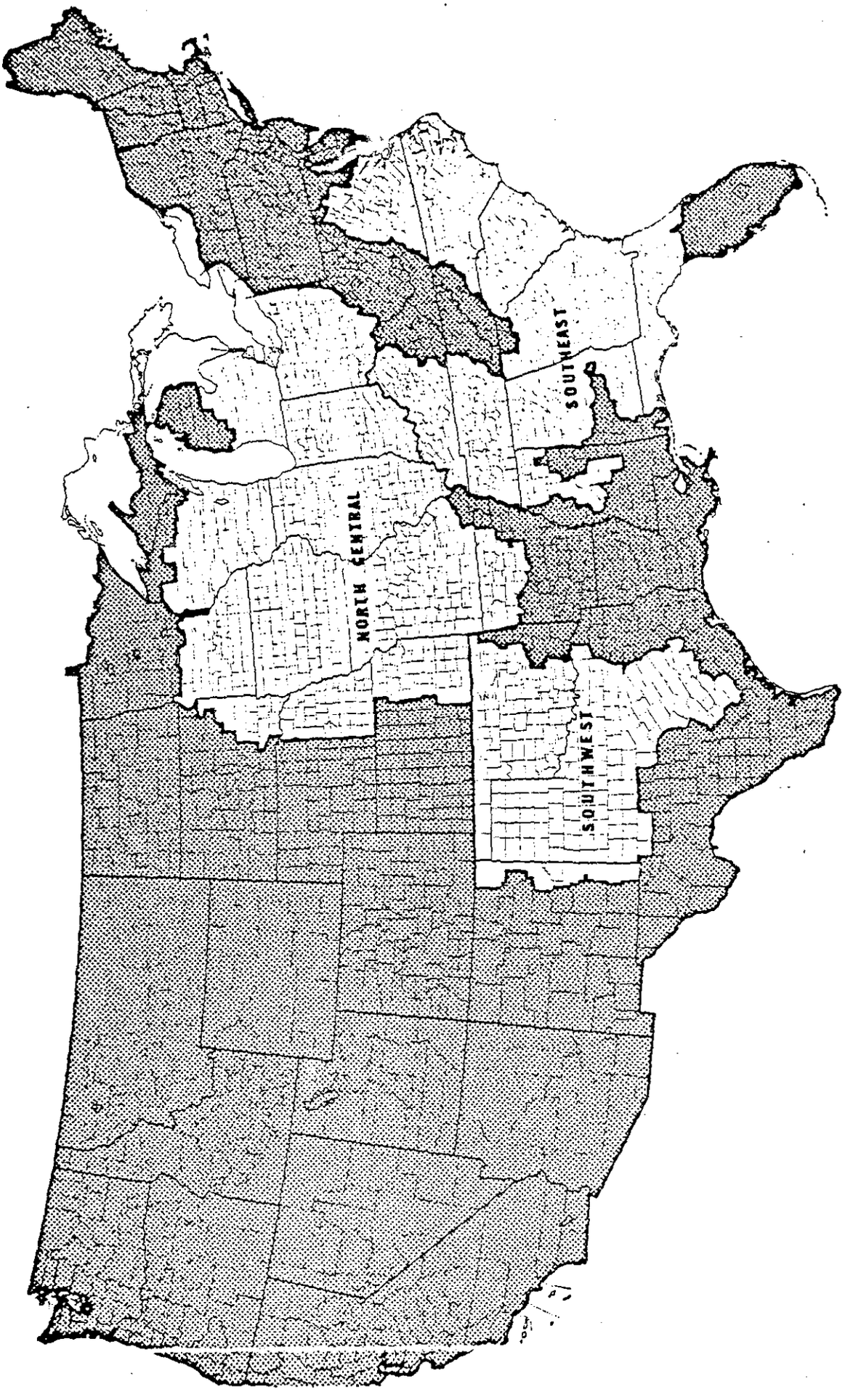


Figure E.3. Hog producing regions (shaded areas were excluded from the survey).

ENDNOTES

1. The Resource Conservation Act Analysis used a partially endogenous livestock model in all of the solutions.

2. There are two water sectors available for use--a flow model and a fixed model. the water availability in either of these models do not include the water used by livestock. In the fixed model, water availability is determined only for endogenous crop production. In the flow model, the water available from aquifers used to irrigate one assumed different from those sources used by livestock.

3. Includes chicken, eggs, and turkey production.

4. In addition, the coefficients for beef, pork, and dairy are presented in Chapter 3. These are provided in case the fully exogenous sector is desired.

5. Discussion over phone, 1980.

6. Feeding efficiency adjustment suggested by animal scientists at Iowa State University.

7. It was decided early in the modelling effort that NIRAP would not provide sate level information (except for land use) in the 1985 effort. Thus earlier solutions of NIRAP were used when required.

8. Primary output is measured in terms of liveweight.

9. Weighted to PA's by using the 1978 Agricultural Census weights.

10. Determined based on calculations from the particular FEDS budget incorporated into the production activity. Note: for each Feds budget a PUD was calculated such that; PUD = (total lbs. of primary product sold by the budget ÷ 100).

11. This is based on the assumption that public grazing costs are a constant $3.20 per A.U.M. and an A.U.M. requires an average of 800 pounds of forage.

12. Other crops are transferred with no objective function value thus assuming that the costs are included in the objective function of the crop production and transportation activities.